2018 TECH PREVIEW

APC

Jan 2018
Issue 450

YOUR EXPERT GUIDE TO TODAY'S TECH

WE DIG DEEP TO UNCOVER WHAT'S IN STORE FOR THE PC IN THE NEXT 12 MONTHS (AND BEYOND)!

APC PRESENTS

HOT HOLIDAY HOW-TOs!

THE GEEK'S GUIDE TO HOLIDAY FUN! DISCOVER HOW TO:

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RESURRECT YOUR FAVOURITE CLASSIC GAMES
BUILD HEAPS OF USEFUL THINGS WITH A RASPBERRY PI

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PRINT POST APPROVED 100000179
ISSN 0728-4415

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PRO TIPS FOR TODAY'S TECH

- → CREATE YOUR OWN VPN SERVER
- → LEARN TO JAM WI-FI WITH A RASPBERRY PI
- → UPGRADE AN OLD PC TO RETURN IT TO GLORY
- → THE COMPLETE GUIDE TO BATTERIES + CHARGING

REVIEWED: NIFTY NEW PCs & TECH

- → MICROSOFT SURFACE BOOK 2: STILL PRICEY, NOW WORTH IT?
- → NVIDIA GEFORCE GTX 1070 TI: THE NEW ENTHUSIAST CHOICE
- → ACER SWITCH 5: A GREAT SURFACE PRO CLONE FOR LESS
- → INTEL OPTANE 900P: CHIP GIANT RETURNS TO SUPERFAST SSDs

WORLD'S THINNEST GAMING DESKTOP?

MSI'S VORTEX G25 JAMS ALL THE POWER OF A DESKTOP GAMING PC INTO A CHASSIS THAT MAKES THE PS4 PRO AND XBOX ONE X LOOK HUGE BY COMPARISON!

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Vigor3900

Qaud-WAN Gigabit broadband router with Security Firewall, 500 x VPN tunnels, and 100 x SSL-VPN tunnels

Ethernet WAN NBN Ready | Ethernet WAN UFB Ready | 500x VPN | 100x SSL-VPN | TAIWAN EXCELLENCE 2012

- 4 x Gigabit Ethernet WAN ports
- 1 x SFP WAN port
- Multi-WAN Load Balancing & Failover
- 2 x Gigabit Ethernet LAN ports with 120,000 NAT sessions
- 1 x SFP LAN port
- 500 x VPN & 100 x SSL-VPN tunnels with Central VPN Management
- High Availability Mode
- Object-oriented Firewall with Content Security Management (CSM) and QoS
- IPv6 x IPv4
- Multi-subnet WAN/LAN through 802.1Q
- Bandwidth management
- 2 x USB ports for 3G/4G LTE mobile broadband access, USB printer, storage, and thermometer
- Support VigorACS SI management system
- Smart Monitor Traffic Analyzer (up to 500 nodes)

Vigor3220 Series

Qaud-WAN Gigabit broadband router with Security Firewall, 100 x VPN tunnels, and 50 x SSL-VPN tunnels

Ethernet WAN NBN Ready | Ethernet WAN UFB Ready | 100x VPN | 50x SSL-VPN | TAIWAN EXCELLENCE 2016

- 4 x Gigabit Ethernet WAN ports
- 1 x USB port (USB3.0) support 3G/4G LTE mobile broadband access
- Multi-WAN Load Balancing & Failover
- 1 x USB port (USB2.0) support file sharing, external storage, network printer or thermometer
- 100 x VPN and 50 x SSL-VPN tunnels with Central VPN Management, Load Balance and Redundancy
- 1 x Gigabit LAN port with 100,000 NAT sessions
- 1 x Dedicated Gigabit Ethernet DMZ port for connecting servers
- 1 x Console port (RS232)
- Object-oriented Firewall with Content Security Management (CSM) and QoS
- IPv6 x IPv4
- 802.11n Wi-Fi for Vigor3220n
- Central AP Management
- Central Switch Management
- Support VigorACS SI management system
- Smart Monitor Traffic Analyzer (up to 200 nodes)

NEW

Vigor2952P

Dual-WAN broadband Fibre router with Security Firewall, 4 x PoE LAN ports (power budget up to 60 Watts), 100 x VPN tunnels, and 50 x SSL-VPN tunnels

Ethernet WAN NBN Ready | Ethernet WAN UFB Ready | 100x VPN | 50x SSL-VPN | TAIWAN EXCELLENCE 2016

- 1 x Gigabit Ethernet/SFP combo WAN port
- 1 x Gigabit Etherent WAN port
- Multi-WAN Load Balancing & Failover
- 4 x Gigabit PoE Ethernet LAN ports with 60,000 NAT sessions
- Complies with 802.3at PoE Plus
- PoE power up to 30 watts for each port
- Total PoE power budget up to 60 watts
- 1 x USB port (USB3.0) support 3G/4G LTE mobile broadband access
- 100 x VPN and 50 x SSL-VPN tunnels with Central VPN Management, VPN Load Balance and Redundancy
- High Availability Mode
- Object-oriented Firewall with Content Security Management (CSM) and QoS
- IPv6 x IPv4
- 1 x USB port (USB2.0) support file sharing, external storage, network printer or thermometer
- Central AP Management
- Central Switch Management
- Support VigorACS SI management system
- Smart Monitor Traffic Analyzer (up to 100 nodes)

i-LAN TECHNOLOGY

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apc

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SUBSCRIPTION ENQUIRIES: Please call Magshop 13 61 16
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ABOUT THE MAGAZINE
APC is published by Future Publishing Australia.

Distributed in Australia and NZ by Network Services.

Printed by Bluestar
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FIPP

What the net neutrality repeal means for Australian internet

Changes could result in slower and more expensive online services, even for us antipodeans.

Under the Obama administration, the Federal Communications Commission (FCC) helped formally introduce 'net neutrality' laws to the US in 2015, which basically classify the internet as a utility like electricity, water and phone services. This means that US internet providers have to provide equal and unbiased access to all companies and individuals who want to use it. Those laws are increasingly looking like they'll be dumped under new FCC head Ajit Pai. Under Pai, the FCC is arguing that net neutrality is anticompetitive, as it restricts the ways in which ISPs can monetise the networks they've built.

If you're not an ISP, however, the repeal of these laws likely spells bad news when it comes to your use of the internet. The only organisations who really want this repeal to go ahead are the big US telcos, who'll be able to legally throttle internet speeds and then charge companies that rely on high bandwidth and low pings to operate extra fees to prioritise their traffic... something many will have no choice but to pay in order to keep their businesses viable – think Netflix, Steam, Activision/Blizzard, EA, Xbox and PlayStation. If these companies suddenly find their operating costs increased, you can bet they'll be passing those costs on to consumers – which may even extend to Australia, for companies that host content on US-located servers. Consumers could, in fact, end up getting gouged at both ends of the transaction, as ISPs may decide to charge additional fees on top of their monthly internet bill for "prioritised access" to streaming services and online games. And tech-oriented Australian businesses might also find themselves in the lurch, having to pay fees to US teclos if they want unfettered access to US internet users.

While there are technically no net neutrality laws in Australia, most local ISPs have so far abided by the defacto rule that access to content and services should be provided without interference – though there are occasional exceptions to this, such as when ISPs or mobile services provide unmetered access to streaming sites like YouTube, Apple Music and ABC iview. With the repeal of net neutrality in the US, it's possible local ISPs may eventually follow whatever strategy their US counterparts employ. There's one thing that may save us from the same fate though: Australia has some of the strongest consumer-protection laws in the world, and the ACCC will likely scrutinise any changes ISPs try to make and decide whether they're anticompetitive and should, therefore, be outlawed. ■

DAN GARDINER
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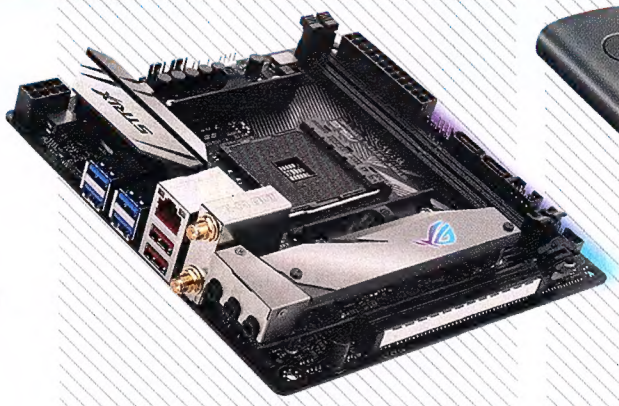

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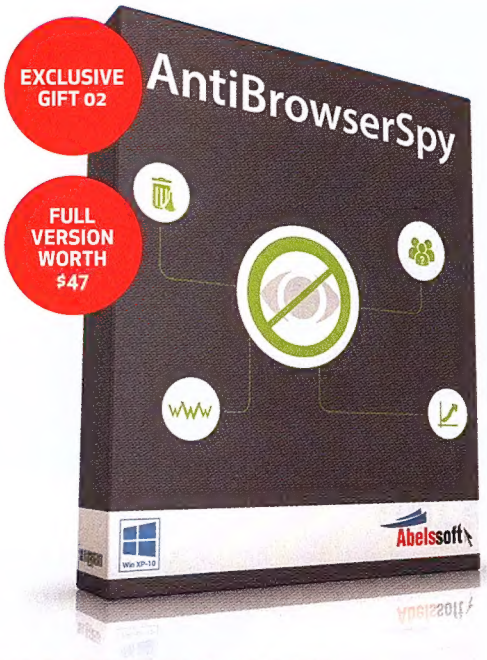

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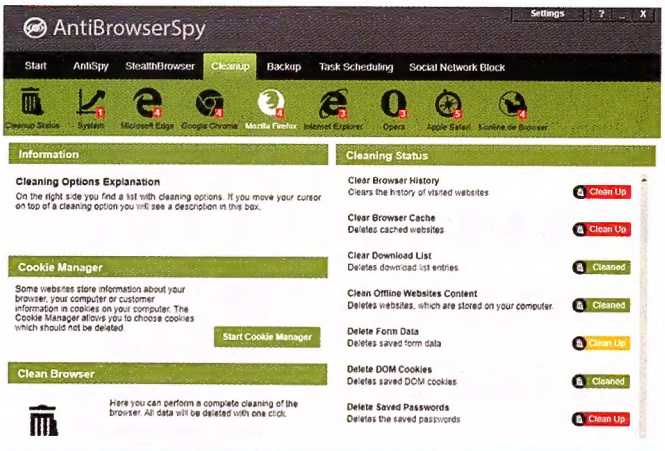

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WORLD'S THINNEST GAMING DESKTOP?

Inside APC

Find out all about *APC*'s editorial policies, test practices, how to read the benchmark results and more.

APC is Australia's oldest consumer technology magazine – having been consistently in print for over 35 years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer – it's in our name, after all – the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech too, from smartphones and apps to peripherals, accessories, online services and beyond. We have two main goals: to track down the best of modern tech and also to help our readers make the most of it.

We're also an open church in terms of platforms. We know most people aren't wed to a single brand's products and use a variety of devices. And like you, *APC*'s journalists want to know what's good in tech – no matter what platform it resides on.

INDEPENDENT REVIEWS

Championing technology doesn't mean we're unrelenting yes-men, however, and *APC* aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three.

As a matter of policy, reviews published in *APC* are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an *APC* reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

LABS TESTING

Despite being a small magazine with limited resources, *APC* still still strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance, gaming and battery life.

In most cases, for the benchmark results published in *APC*, you can assume that higher is better. There are certain tests that deviate from this rule and where the opposite is true; in those cases, we've flagged the results with a note explaining as such.

We use both tables and graphs for displaying results; the latter are our preference due to their ease-of-readability, but tables are more compact, so we use these in cases where thoroughness is preferred.

technotes

» NEED TO KNOW

New UK bill will give cops the power to ground and seize drones

ALONGSIDE RULES THAT REQUIRE DRONE REGISTRATION AND TAKING 'SAFETY AWARENESS' TESTS.

The UK Government is taking a hard stance on drone regulations. Rules were put in place earlier this year that required drones weighing over 250g to be registered and owners take a 'safety awareness' test to prove they understand the regulations. Now the UK Government is drafting a new bill that will give British police the power to not just ground but also seize drones they think are being used to commit an offence. Simply called the Drone Bill, it might even ban the use of drones flying over 400ft near airports. **SS**

Personal information of AI.type virtual keyboard users has been exposed

APP MAKER'S DATABASE WASN'T PASSWORD-PROTECTED.

A lot of third-party apps collect user information, and AI.type is no exception. This popular keyboard app for both iOS and Android requires "full access" upon installation and has a directory of over 31 million users — a list that wasn't even password protected. Discovered by a security company, the database contains sensitive information including not just contact details and names, but also phone models, linked social media profiles, mobile network and location details. Although the database was available publicly for a while, AI.type has confirmed that it is now secure. **SS**

State governments unsure if 'loot boxes' in games should be classified as gambling

Victoria and Queensland disagree on the money-for-perks system.

Two Australian states have commented on the recent 'loot box' trend in gaming, and can't agree if unseen and random rewards in videogames bought with real money should be considered to be a form of gambling. EA's recent release, *Star Wars: Battlefront II* features loot boxes, digital treasure chests that contain rewards to be used in-game but the contents of which are only revealed once you've spent actual money on them.

While *Battlefront II* isn't the only game to include them, it's the most (in)famous example. While speaking to Kotaku, Jarrod Wolfe of the Victorian Commission for Gambling and Liquor Regulation, says that "what occurs with 'loot boxes' does constitute gambling by the definition of the Victorian Legislation", while Robert Grimmond of Queensland's Office of Liquor and Gaming Regulation says "video gaming which provides for 'loot boxes' would not fall within the meaning of a gaming machine as defined under the Gaming Machine Act". While the controversy rolls on, it's clear that the next game to feature loot boxes will endure more scrutiny. **Paul Taylor**

ACCC launches investigation into Facebook and Google's media influence in Australia

THE WATCHDOG WANTS REASSURANCE THAT INTERNET GIANTS ARE PLAYING NICE WITH TRADITIONAL NEWS OUTLETS.

Internet giants Facebook, Google and Twitter have been in the spotlight for their role in politics, but now Australia wants to investigate these companies' impact on our news services. With traditional print media being squeezed out by online news sources, and more advertising money being siphoned into digital media, often leading to journalism job cuts, the Federal Government has instructed the Australian Competition and Consumer Commission (ACCC) to probe into the effect distributors like Facebook and Google have on competition in the media and advertising industry.

"We will examine whether platforms are exercising market power in commercial dealings to the detriment of consumers, media content creators and advertisers," ACCC chair Rod Sims said. Although Google is looking "forward to engaging with this process", Facebook is yet to comment. This investigation is part of media reform negotiations that took place in Parliament in 2017 and resulted in the country's big media houses getting the freedom to boost their market share. The report is due in 2019. **Sharmishta Sarkar**

Lawsuit accuses Google of spying on iPhone users

COMPLAINTANTS INTENDING TO "SEND A STRONG MESSAGE TO TECH GIANTS".

A UK lawsuit has been launched against Google, accusing the internet giant of bypassing default privacy settings on the Safari browser for iPhones, and planting cookies that steal a user's data in order to sell it to advertising networks. The suit has been put forward by a consumer activist campaign group — fittingly titled Google You Owe Us — and represents roughly 5.4 million iPhone users affected between 2011 and 2012, with the potential to claim a payout of hundreds of millions of dollars. **HD**

Facebook halts ability to block ethnic groups from targeted advertising

THE PAUSE IS IN PLACE WHILE THE BLOCK'S EFFECTS ARE INVESTIGATED.

When advertising on Facebook, organisations have previously had the option to exclude specific racial and ethnic groups from being served their ads via a feature known as "multicultural affinity marketing". A group of black lawmakers in the US have recently criticised this feature, prompting the social media giant to pause advertising vendors' ability to use it. The feature was critiqued due to its capacity to be used to discriminate against minorities, and so Facebook has stated that it's suspending this functionality while it investigates how it can "better ensure its tools will not be used inappropriately". **HD**

AI alarmism is bullsh*t, says EU research commissioner

DON'T BELIEVE THE ALARMISTS, SAYS ONE EXPERT.

Though intellectual icons like Stephen Hawking and Elon Musk have conditioned us to believe that artificial intelligence will eventually cause the downfall of humanity, EU Research Commissioner Carlos Moedas thinks most opinions on AI are BS. Calling negative articles on AI "fake news", Moedas believes "fearing what is arguably one of the most exciting new technologies of our generation and denying ourselves its amazing benefits is not the answer". **SL**

New ARM-based Windows laptops could offer 20+ hour battery-life

Microsoft and Qualcomm team up for second stab at 'best of both worlds' portable PCs.

At chip-maker Qualcomm's annual Tech Summit in December, ASUS and HP showed off the very first Snapdragon-powered Windows 10 notebooks, signalling the second attempt at a Microsoft and ARM team-up.

Microsoft first tested the ARM waters back in 2012 with the Surface RT tablet, although that venture ultimately proved unsuccessful due to the locked-down Windows RT operating system and inability to run anything outside of Windows Store apps – where the selection was lacklustre.

These new ARM devices could finally deliver on the concept, with the 2-in-1s ASUS and HP demoed promising over 20 hours of battery life, the ability to instantly wake with an always-on state, and most significantly, operate on a full version of Windows 10 that can still run all Windows apps.

While Microsoft has partnered with Qualcomm for these initial Windows devices, the move away from Intel's x86 processor technology could potentially open up the market for a much wider array of ARM-based devices, with manufacturers like Samsung, Nvidia and even Apple all currently producing their own ARM-based chips. And speaking of the iPhone-maker, there have been rumours floating around that the company has been considering its own ARM-powered MacBook for some time... although it seems like Microsoft may have beaten the iPhone-maker to the punch. **Harry Domanski**

NBN Co pausing HFC rollout

WILL FIX EXISTING PROBLEMS FIRST.

If you've been hanging for a hybrid fibre-coaxial (HFC) upgrade to your internet connection, you're going to have to wait a while longer — as NBN Co has announced that it's temporarily putting its HFC rollout on hold while it focuses on improving "end user experience and retailer satisfaction".

According to NBN Co, the purpose of its "new initiatives" is "aimed at raising the standard of service quality when declaring the Hybrid Coaxial-Fibre as 'ready to connect (RTC)' ". The company has also stated that the changes will "also help to further improve the reliability of the network".

Of the one million premises that are classified as RTC for HFC, the 370,000 end users that have already taken the plunge will be first to see the benefits of the new initiatives, while the rest could end up waiting several months for the improvements. "We remain confident of reaching our goal of completing the build and connecting eight million Australian premises by 2020," said Bill Morrow, NBN Co Chief Executive.

Stephen Lambrechts

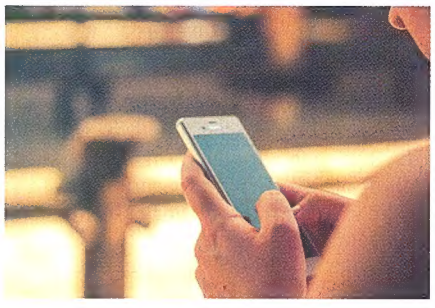
numbercrunch

» HARRY DOMANSKI LOOKS AT THE NUMBERS DRIVING THE BIG TECH NEWS

$18000

AMOUNT OF MONEY A 19-YEAR-OLD GAMER HAS SPENT ON MICROTRANSACTIONS

As the conversation surrounding video-game microtransactions reaches fever pitch, Reddit user Kensgold has presented an open letter on the issue titled, "I am 19 and addicted to gambling". The letter is addressed to EA (the publishers behind the controversial *Star Wars: Battlefront II* title) as well as other developers in the industry and, despite not blaming the companies directly, is a plea to raise awareness of the dangers of microtransactions. Kensgold claims to have spent over US$13,500 (close to AU$18,000) on in-game purchases in recent years.



5th

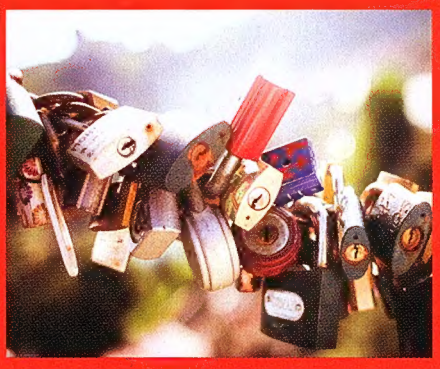
OUR WORLD RANKING FOR MOBILE INTERNET SPEEDS

A new report released by Ookla — the company behind SpeedTest.net — has revealed that Australia ranks an impressive fifth globally in terms of mean download speeds over its mobile data networks, squeezing in ahead of Singapore, and just getting beaten by the UAE. The report measured the average download speed in Australia as 44.2Mbps mobile broadband, while fixed-line broadband only managed an average of 24.1Mbps. Norway, The Netherlands and Iceland took out the top three mobile broadband spots, with speeds ranging from 50–60Mbps.

88%

PERCENTAGE OF AUSTRALIANS THAT HAVE SHOPPED WITH OVERSEAS ONLINE RETAILERS OVER THE LAST YEAR

Amazon's Australian launch is looking very cleverly timed, with a recent study by US tech research firm Pitney Bowes showing that 88% of Aussie shoppers have bought goods from overseas retailers in the last year. The most popular reason for shoppers to choose international alternatives was the price difference, according to the survey, with two thirds of respondents citing this as their main reason for shopping abroad, followed by the increased selection of products on offer, which persuaded 42% of customers to do the same.



9 out of 10

NUMBER OF AUSSIES USING THE SAME PASSWORD ACROSS ACCOUNTS

With the prevalence and impact of cybercrime continuing to rise every year, it's perhaps a little concerning that roughly 9 in 10 Australians admit to using the same password across multiple accounts. According to a survey conducted by ME Bank, not only did 89% of the respondents reuse passwords, almost half of the 2,000 mobile or tablet users surveyed shared their passwords with others, with over two-thirds of the survey group blaming the frustration of setting up and remembering multiple passwords for their habits.

77%

PROPORTION OF AUSSIES THAT BELIEVE PERSONAL SCREEN TIME CAN LEAD HOUSEHOLDS TO FEEL MORE APART

A survey conducted by LG Electronics and data analysts Core Data has found that Australians have some severely mixed feelings about their devices during the Christmas period. While around 84% of those surveyed believe that home entertainment technology "allows families and friends to share experiences" and that TVs bring us closer together, 77% of the same survey group thought that personal device use makes households grow further apart. ■

techbrief

» CARMEL SEALEY WADES INTO A CURRENT NEWS TOPIC TO TAKE A CLOSER LOOK

The new reality

How are virtual and augmented reality changing education?

Imagine this: It's your first lesson of Ancient History and you're excited to learn about Julius Caesar. You sit down at your desk, but instead of a text book on your table, there's a virtual reality headset. The teacher arrives and cries, "Everyone, put on your headsets and begin the Rome 44 BC environment!"

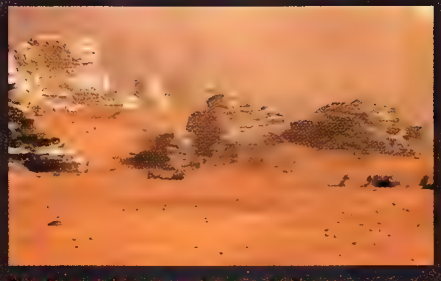
This could be the future of education, thanks to the power of virtual reality. Being completely immersed in a setting could provide a new avenue of education for children – encouraging an active rather than passive interaction in the classroom, and removing all possible distractions.

The subject of mathematics could also undergo a dramatic change, with students able to see and manipulate objects in 3D in order to solve problems. Students studying architecture could virtually walk through their masterpieces to tweak their design. Budding electricians could explore from all angles a complex circuit to identify faults. Future palaeontologists could even walk with dinosaurs.

The possibilities are endless, but the first steps towards this reality have already been made...

Training simulators for army personnel

With the rise of VR, companies such as Plextek have come up with simulated training exercises, providing a cheap and safe environment in which to train. While the video quality is obviously not as crisp as real life, the simulations are reportedly good enough to reflect the horror of battle for the soldiers. Good...?

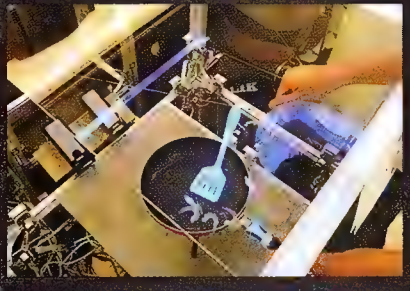


Take a bus trip to Mars

Back in 2016, a group of lucky kids from the US were taken on a special bus trip. With the windows decked out with screens, the familiar streets of Washington DC faded to the landscape of Mars, a constructed environment designed to move at the same pace as the bus. It was created with the intention of stirring up interest in space. Job done, we say!

360° videos help connect children to the land

What better way to explore the natural wonders of Australia from the comfort of your own classroom than to watch 360° videos? Using drones and tripods, the team behind these videos has managed to capture some truly beautiful locations, such as the Blue Mountains. Each video features a local Aboriginal ranger, who explains the names of places, teaches the viewer native words and tells stories of the land. The viewer is free to look wherever they wish. These videos give children access to places they may not be able to visit on a school trip. We only wish they were longer. If you have access to a computer, head here and watch some of these incredible videos yourself: **tinyurl.com/apc450-360video**



Augmented reality and the art of cooking

A team from the Tokyo Institute of Technology has created an elaborate system to teach people to cook. Using a metal frame in which is suspended a frying pan and separate handle (acting as a spatula), the user looks through a glass screen to see an augmented reality overlay of a steak, vegetables and other tasty things being tossed around in the pan, reflecting the user's movements.

Medical students use VR to watch surgical procedures

Yes, this is actually happening right now. Filmed using a 4K 360° camera system, entire operating theatres are captured by the Medical Realities Platform for the benefit of medical students around the world. The videos see you, the viewer, standing in the prime position, watching as the "world-class surgeons" operate. You can watch how the team interacts, as well as separate anatomy videos to let you "explore in detail". Cool, but ew.

gadgets

» GEAR WE WANT

SAMSUNG GEAR SPORT

Sporting the latest smartwatch.

$499 | WWW.SAMSUNG.COM

After the initial honeymoon period, for many owners, the need to charge a smartwatch every night or two can become grating, but Samsung has added a number of premium fitness tracking features to its new Gear Sport that could make the effort worth it. The most notable of these is Spotify integration, which'll let you download songs for offline listening, and this combines with integrated GPS tracking to allow you to leave your phone at home when you exercise. Add to this 50 metre water resistance, Under Armour app integration, a Speedo swim tracking app, guided workouts, diet tracking and Samsung Pay, and it's clear the Gear Sport is a smartwatch you'll never want to take off. **JB**

iROBOT ROOMBA 980

Carpet diem.

$1,499 | WWW.IROBOT.COM.AU

We currently exist in a brief window of history where robots are smart enough to do our vacuuming for us, but haven't yet developed the intelligence to mount that inevitable AI coup that has to be just around the corner. iRobot has taken full advantage of this golden era, building some of the best silicone slaves in the robot vacuum market. The Roomba 980 can map an entire level of your home before systematically scraping it for dust and crumbs. The connected smartphone app even lets you control the exact schedule of the Roomba 980, which means the only thing you can't seem to make it do is fly up the stairs... something that drone integration could easily fix. iRobot, you know what you have to do. **JB**

SONY WH-1000XM2

Raising the barometer for noise cancelling.

$499.95 | WWW.SONY.COM.AU

While the visual design of Sony's WH-1000XM2 over-ear headphones isn't particularly loud (coming in only black and rose-gold colourings) one thing's for sure: these cans' noise cancelling is dead silent. Adding to the features of its predecessor, the MDR-1000Xs, Sony's latest travel-focused wireless noise cancelling headphones include a barometer to perfectly calibrate its advanced noise-cancelling features to match an aeroplane's cabin pressure. While the noise cancelling segment isn't known for its musical fidelity, these new cans also feature high-res audio over Bluetooth and a great set of 40mm neodymium drivers for impressive overall audio quality. **JB**

TESLA ROADSTER 2.0

Leaving traditional supercars in the dust.

FROM US$200,000 | TESLA.COM

Admit it: you thought electric cars were a nice, eco-friendly idea, but that none could ever be sexy enough or fast enough to replace a gas-guzzling, high-performance sportscar. Well, prepare to backtrack significantly by saying hello to the new Tesla Roadster, an all-electric supercar that's spoiling for a fight with petrol-powered rides. With the Roadster, Tesla is looking to set a new benchmark for the world's fastest car. It's a record currently held by the Agera RS, which throws down at 447.24km/h; the Roadster's top speed is said to be above 402.34km/h, but an exact figure has yet to be confirmed.

In the meantime, there's plenty else to get excited about here: 0–60 in 1.9 seconds — the first production car to break the two-second mark — and a whopping 998km range... and those stats relate to the basic Roadster — there'll be an option to increase the car's brain and brawn (along with the price, naturally) nearer to the 2020 release date. Needless to say: we want.

BOSE SLEEPBUDS

The crowdfunding project to help you sleep.

US$249 | TINYURL.COM/APC450-SLEEP

APC Towers are being terrorised by a seagull. Every morning around 5am (yes, some of us pull all-nighters to bring you the best quality content possible), the squawking begins and it doesn't let up until we throw open a window and squawk back. You might be dealing with a rogue seagull, too, or perhaps your partner just snores. Whatever sounds keep you from uninterrupted sleep, Bose wants to solve the problem with its noise-masking Sleepbuds.

These rechargeable buds have built-in flash memory containing pre-loaded soothing sounds, designed to mask external noises but to fade from attention so as not to distract you from sleep. You can set an alarm (via the Bose Sleep app) to play through the Sleepbuds, ensuring you don't wake your partner, while StayHear+Sleep Tips promise to stay in and comfortable the whole night.

ULTIMATE EARS BLAST

Big bada-boom.

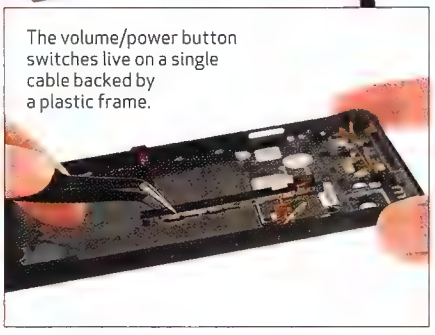
US$229 | WWW.ULTIMATEEARS.COM/EN-AU

Whenever we see an Ultimate Ears speaker we think, "Par-tay!" These speakers were built for living life loud wherever you are, and the new Blast speaker is no exception. Waterproof and portable, the Wi-Fi/Bluetooth Blast lives up to its name by blasting any room it's placed in with nuanced 360° sound for up to 12 hours. Alexa has become a smarter way of life for many, which is why we're stoked to find it built into the Blast speaker, enabling slick voice control of music playback and the full gamut of Alexa's skills — smarthome control, scheduling meetings... you know the drill. Because the Blast is waterproof (and handily drop-proof), you can get a jumpstart on sluggish early mornings by taking the Blast in the bathroom while you shower. "Alexa, play my 'Morning Jams' playlist." ■

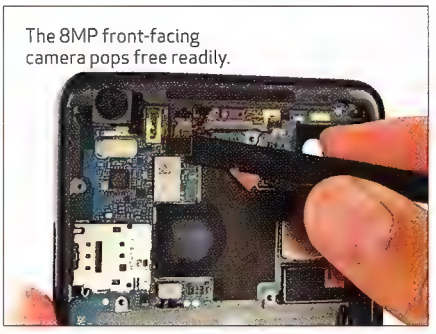
howit'sdone

Google Pixel 2 XL

Is Google's latest as easy to take apart as it is to squeeze?



The volume/power button switches live on a single cable backed by a plastic frame.



The 8MP front-facing camera pops free readily.

Google revolutionises the smartphone market with the Pixel 2 XL, offering new squeezability. We're hoping a teardown will reveal just how huggable it is.

MAJOR TECH SPECS:

- 6-inch plastic-OLED (POLED) display with QHD+ 1,440 x 2,880 (538ppi) res and 3D Gorilla Glass 5
- Octa-core, 64-bit Qualcomm Snapdragon 835 processor (2.35GHz + 1.9GHz) with 4GB LPDDR4x RAM
- 12.2MP, f/1.8 main camera, with dual-pixel phase detection autofocus and laser detection autofocus; 8MP selfie camera
- 64GB or 128GB built-in storage
- Pixel Imprint back-mounted fingerprint sensor
- IP67 water and dust resistant
- Android 8.0 Oreo

KEY FINDINGS

- The Pixel 2 XL is a waterproof phone, which means all the ingress points must be sealed. We find our first evidence of Google's efforts in a gasket on the SIM tray. We leave the iOpener behind, as the Pixel 2 uses foam tape that can be separated without heat. Inside are long cables – a welcome respite from treacherous openings with past smartphones.
- We have to untether the display before going further. Its two cables are secured by plastic plugs in the midframe, and they only come out with some encouragement from a hefty pry tool. As in the original Pixel XL, a magnesium midframe separates the display from the innards, and provides a solid backing behind the display. Piggybacking on to that midframe, we find a brand new heat pipe. Looks like this phone might run a bit hotter than its previous incarnation.
- Last year, the HTC-built Pixel XL showed us a novel way to remove an adhered battery—a perforated outer label let you pull the battery out of its shell, then easily peel off the rest of the label. This year, it seems LG's industrial design doesn't include any provision for easy battery removal.
- We peel back some copper tape to unleash the XL's beast of a main camera. Although the megapixel count on this camera is close to last year's, the similarities between the sensors end there. This year, Google switched to a dual-pixel sensor, added optical image stabilization, and opened the aperture up to f/1.8 from last year's f/2.0.
- Along with a few other connectors, all that's holding the motherboard in place are the midframe screws. The 8MP front-facing camera pops free readily, and can rest easy, knowing it's a full megapixel better than the latest iPhone offerings. With the meat of the Pixel pulled out, we just have a few case peripherals to attend to.
- **Repairability Score: 6 out of 10** (10 is the easiest to repair). Many components are modular and can be replaced once the display assembly is removed. All the screws are common Phillips #00 screws. The display is still thin and poorly supported, especially around the grilles, but foam adhesive makes the opening process easier. The battery's loss of pull-tab adhesive, plus tightly walled-in placement, makes it harder to remove. The stubborn midframe and tight-fitting display cable mean more labor-intensive repairs. ■

About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit: **www.ifixit.com**

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PIXEL IMPERFECT

I'm an Android fan who's owned every other Samsung Galaxy Note since they first came out but thought it was finally time for a change. Doing the maths, I decided it was more economical to buy a handset outright rather than tie myself to a carrier for another two years. After months of research, I decided on the Google Pixel 2 XL.

I set about learning the slightly different Android quirks of Oreo (version 8.0) and downloaded the two or three apps that I felt I needed. I noticed after two or three days that the phone had been spontaneously restarting without warning or reason while not in use.

Fearing I had downloaded an incompatible app, I removed most of the apps on the phone, just keeping the bare bones and Sophos Mobile Security, that I installed based on your recommendation.

Much to my chagrin, this did nothing to alleviate the issue – if anything, it got worse. I keep the phone on my desk at work and sometimes see it restart three or four times in a row without having touched it for a few hours and with no apps running at all.

According to online forums, I am not the only one having this problem, and Google has known about this issue for some months; however, they have not yet apparently been able to identify the root cause or apply a patch or fix.

I am now torn between putting up with the problem in the hope that Google comes up with an update that solves the issue or request a full refund and buy the newest Samsung Galaxy Note 8 instead!
Steve Dark

Carmel Sealey replies: *After Steve sent us the initial email, he decided to issue Google a bug report – like so many other users have done. Within days, a minor update was released, which, upon installing, appears to have solved the issue. His phone no longer reboots spontaneously and is otherwise performing very well. After doing a little digging online, there is some speculation that the problem could be down to the modem causing "kernel panic" when in LTE mode; however, this is yet to be officially confirmed by Google.*

> "Fearing I had downloaded an incompatible app, I removed most of the apps on the phone, just keeping the bare bones and Sophos Mobile Security, that I installed based on your recommendation."

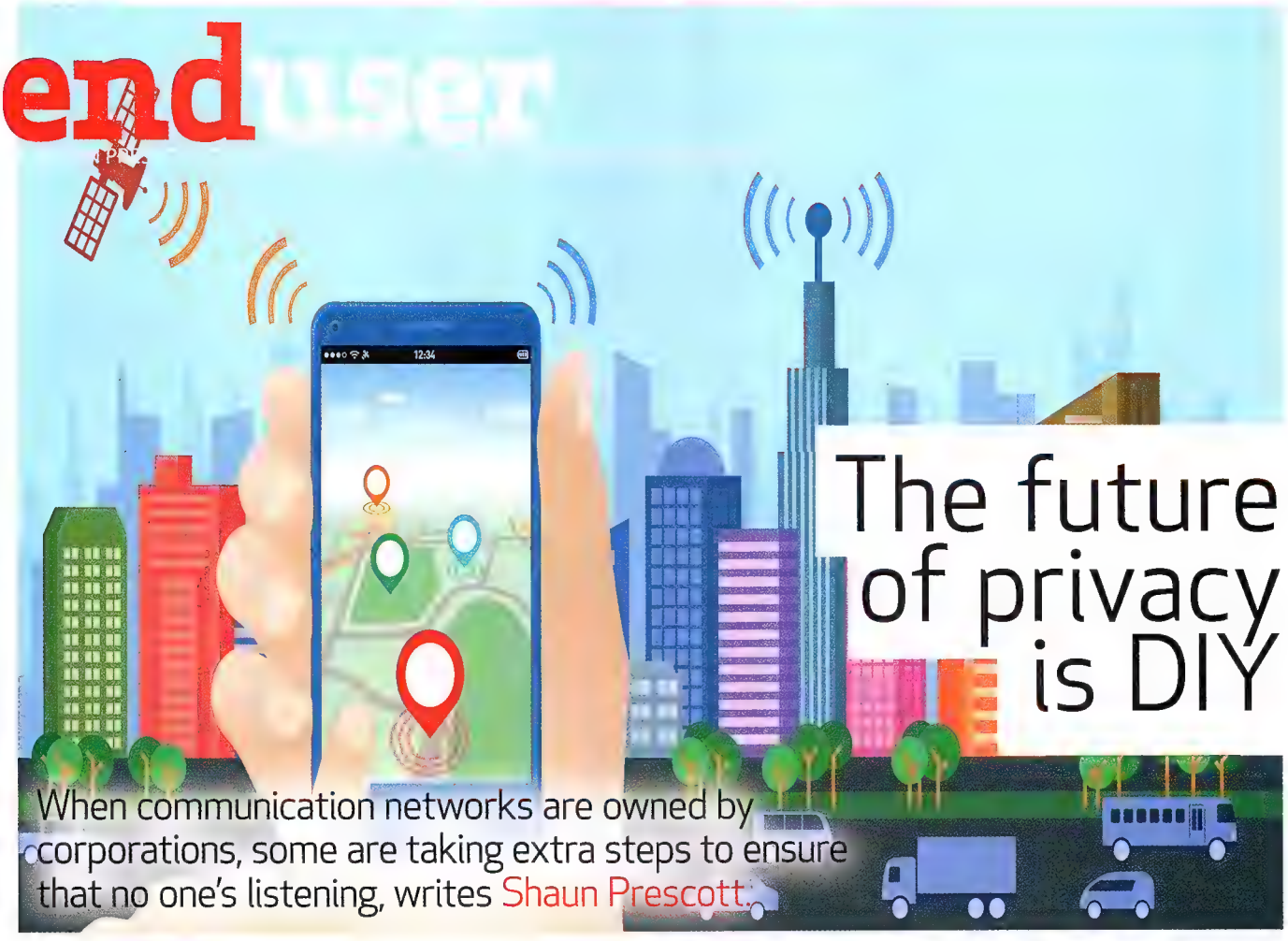
One particular user has claimed the problem can be solved by switching to 3G only – by heading to 'Settings › Network and Internet › Mobile Network' and changing the preferred network type.

Steve also notes that the Google forum on the issue remains active, so if you are also experiencing this problem and any recent software updates have done nothing to help, perhaps visit the forum yourself:
tinyurl.com/apc450-pixel ■

APCMAG@FUTURENET.COM

Come on, have your say!

We want to hear what you think. Add to these discussions or email your views (in fewer than 250 words) to **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.



The future of privacy is DIY

When communication networks are owned by corporations, some are taking extra steps to ensure that no one's listening, writes Shaun Prescott.

Despite providing assurances that they value your privacy, the uncomfortable truth about telecommunications companies is that they can pretty much trace your every move and chart your every communication. There's not much you can do about it, and Australia's data retention laws mean they're definitely collecting your metadata, though most likely not perusing it. For most, that metadata sitting in a vault somewhere won't ever come back to bite, but it's still a huge amount of trust that we place in the hands of these gargantuan companies and, by extension, our (often technologically inept) governments.

On a macro-scale, the data retention laws require telecommunications companies to hold onto phone and computer metadata for 24 months. Whether you want to take a principled stance against this surveillance or whether you're operating a basement trade in counterfeit Cuban cigars, there are ways to guarantee privacy, and now DIY moble phone networks are a thing.

Sopranica is a US-based open-source mobile phone network with the promise of anonymity. With Sopranica, metadata cannot be captured by any network provider. It's reasonably easy to join, with only three steps required: install a Jabber app, which is an XMPP app supporting instant messaging, voice and video calls. Then you'll need an SIP (Session Initiation Protocol) app, which helps your phone use the internet rather than a mobile phone network to receive and make calls. Once done, Sopranica's website can generate a phone number for you, unlockable with your Jabber ID, and then... you're pretty much done.

Sopranica is based on the JMP code published by creator Denver Gingerich. This relies on an internet connection, but there's also a component called WOM – a community-run radio network – which require towers, like normal mobile phone networks – ie. expensive physical infrastructure.

So while it may be a while before a DIY phone network is possible in a true roaming sense, Gingerich is prototyping WOM nodes that would cost less than US$100. All this means, naturally, that roaming Sopranica users are putting their faith in other Sopranica users (the hosts of those WOM nodes) rather than in major telco companies.

While still in its infancy, the idea demonstrates that not only are people concerned about data retention and government surveillance, they're also able to take steps to bypass these routes entirely. It could very well be possible to remain 'connected but off the grid' in the future (though you'd need an invisibility cloak to fend off those thousands of security cameras). Whatever the case, the once liberating technology is now increasingly being used against us; but there are still opportunities to wield it without paying the price of our privacy. It'll just take a concerted amount of effort and collaboration. ■

END USER

Share your stories!

If you have an interesting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

Head to head: macOS vs Windows vs Linux

Alex Cox attempts the impossible, pitting the three major operating systems against each other in a head-to-head battle.

It's a subjective tussle as old as time (OK, not quite that old). What should you be running? What will make your computing life easy, and what will make it a living hell of crashes and bugs? We've pulled in the three big operating systems: Windows, macOS and (presented in catch-all broad strokes) the entire Linux ecosystem. We have repeatedly banged our heads against all three over the past couple of decades, not just as desktop operating systems, but as servers, single-task machines and so on. So we've chosen to pitch them in battle over five categories that really make a difference. Let's fight!

macOS

macOS: A collection of small iterations and Apple's customary clean lines.

Round 1

HARDWARE COMPATIBILITY

Windows' advantage as the largest operating system means the vast majority of devices offer 100% compatibility with it, generally straight out of the box, at least in recent times. Get something new, plug it in, and it'll work; if it doesn't, the latest drivers are just a few clicks away, and they're usually bang up to date with the latest patches and updates.

The same cannot be said for Linux – while the hard work of its community means a huge amount of hardware works just fine through open-source drivers, many of which are built in to the kernel, and thus available right away, it's rare for manufacturers to keep their drivers up to the same standard. The demand isn't high enough to justify the effort, particularly given that closed-source drivers tend to make the open-source community foam at the mouth and bang their fists.

The Mac's narrow hardware platform gives it a big advantage when it comes to peripheral compatibility, and most manufacturers are happy to support it. But beware – cook yourself up a Hackintosh, and you'll find that forcing non-standard hardware to work with macOS is an arduous task.

WINNER: Windows

Round 2

SLICKNESS

Apple's commitment to user experience is hugely evident in macOS, with all sorts of bells, whistles, and subtle niceties that make using it really rather pleasant. Aesthetically, it hasn't changed a huge amount since the introduction of OS X in March 2001, apart from flattening out a little, but it's had a bunch of navigational features tacked on – not all of which mesh together into a cohesive whole, it has to be said.

Windows is even more guilty of mixing up its styles. Recent iterations have seen a lot of simplification and forced friendliness crowbarred in, but plenty of old-school components remain, and this sometimes muddies the waters. Windows 10 is the slickest Microsoft OS yet, but its long legacy of minor changes means there's plenty of inconsistency on board.

And Linux? Well, Linux can be wonderfully slick. If you were to install the right desktop, and piece together the perfect selection of widgets, you could make it amazing – you really are spoiled for choice. But then you'll also need to put in the hours to make them work together without breaking, and whisper the secret magic word in exactly the right way.

WINNER: macOS

Round 3

COST

Unless you're picking up a niche distribution packed with closed-source components for a very specific business-related purpose, with a support package tacked on to make sure someone else is on hand when you break it, Linux is absolutely free. You do not have to pay a single cent. Don't like the version of Linux you've downloaded? Then go grab another, and don't pay for that one either.

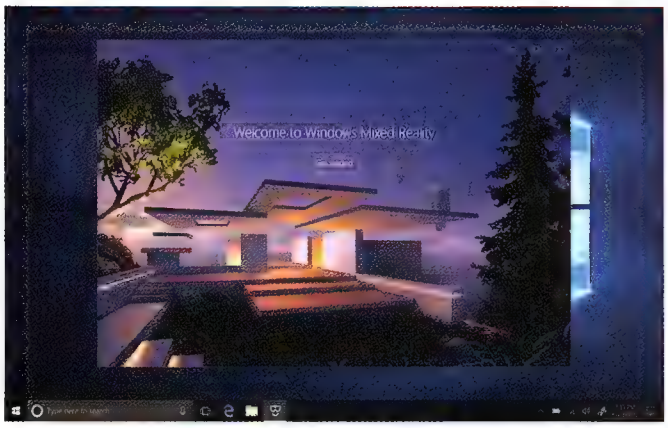
Credit, almost, to Microsoft, as well: It made Windows 10 a free upgrade for a while (a semi-charitable way to push as many users on to its new operating system as possible), and seems to have dropped the concept of new paid-for upgrades altogether. Buy a Windows 10 Home licence for $199 and, if things stay as they are, you're set ad infinitum, at least until you need to install another copy on a new machine.

Apple hasn't ditched new versions, but it no longer charges for them. Indeed, it hasn't sold an operating system directly since OS X Snow Leopard, and that can be had for only $30.99 if you need to refresh an old machine. The meat of macOS, and its subsequent updates, are paid for by the premium you have to pay for Mac hardware.

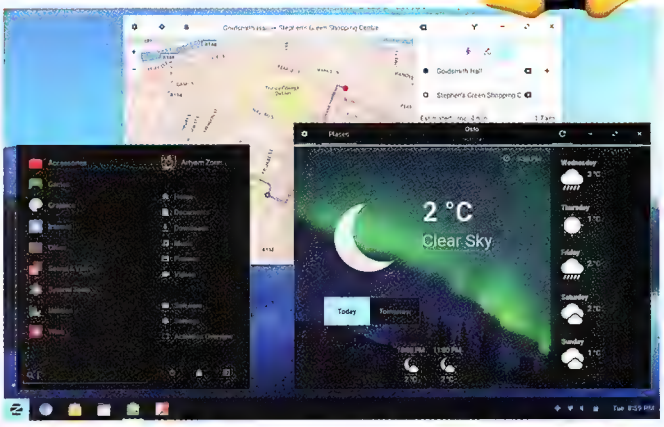
WINNER: Linux

"If you're a gamer, you want Windows — no question. Developers simply aren't inclined to pour resources into putting games on niche platforms — see Valve's not-entirely-successful Steam Machine project for proof."

Windows



Windows: Constantly evolving and the biggest operating system going.



Linux: Sometimes sexy (like Zorin, pictured), but always practical.

Round 4

SOFTWARE

If you're a gamer, you want Windows — no question. Developers simply aren't inclined to pour resources into putting games on niche platforms — see Valve's not-entirely-successful Steam Machine project for proof. That's not to say there's not a large selection of games available for Linux or macOS, but you'll find a lot more for Windows.

Creative software has traditionally had a home within the stable, work-friendly environment of macOS, and it's certainly a great choice for hosting Adobe's Creative Cloud suite. However, running Windows doesn't preclude you from doing that, and — again — Windows' ubiquity is a huge factor in its software selection, with stacks more practical apps on offer.

Let's just not talk about the Windows Store, though: it's awful. Apple has fared much better with the App Store on macOS, but Linux scrapes it here. It's built around distribution networks, which pull the right software for your machine, and install it automatically. Yes, with a little cunning using WINE, you can convince just about any Windows app to run emulated on any platform, but we have to give this to Microsoft's OS in the end. Why work for it?

WINNER:
Windows

Round 5

VERSATILITY

There's a flavour of Linux for just about everything you can think of. From incredibly specific single-serving uses to desktops, servers, and enterprise machines, someone has probably already done the hard work of piecing together a custom distro. Even if they haven't, it's entirely possible to do it yourself, with distros such as Slackware and the Linux From Scratch project helping you start from nothing and build from there. Linux is also suited to a much wider range of hardware platforms. It can run on ARM devices, and you can find distros that run well on very old hardware.

Windows 10 comes in many (very similar) flavours, there's a little ARM support in the form of the free Windows IoT, and the Windows Server enterprise-level series exists, but that's the end of the line. Apple, meanwhile, doesn't even go that far. You can have macOS, or macOS with the Server upgrade, purchasable from the App Store. Of course, it only takes a little imagination to use Windows or macOS for whatever task you decide to set them to, but Linux's open-ended structure means it's what the operating system was meant to do from the start.

WINNER:
Linux

And the winner is...

This clash was by no means a foregone conclusion, and objectively, it's fair to say that no OS truly dominates. Perhaps the results don't match your own feelings or experiences. We won't argue. That's the thing about operating systems: they're subjective and they're personal. They're the direct connection between you and your computing experience, and your own choice is going be based on what matters to you most.

For us, Windows wins, primarily because being part of the largest crowd means you get the biggest software benefits, the widest range of support, and updates generally hit Windows first. Despite all this, it wasn't an easy win for Redmond's juggernaut OS, and that wide user base puts a malware-shaped sting in its tail.

As pleasing as macOS is to use, getting it on any non-Mac hardware means shattering a lengthy EULA, and potentially a lot of work toward hardware compatibility — but the same is not true in reverse. And as mature as Linux has become, and as ethically noble as it is, we still can't trust its stability as a daily desktop. ■

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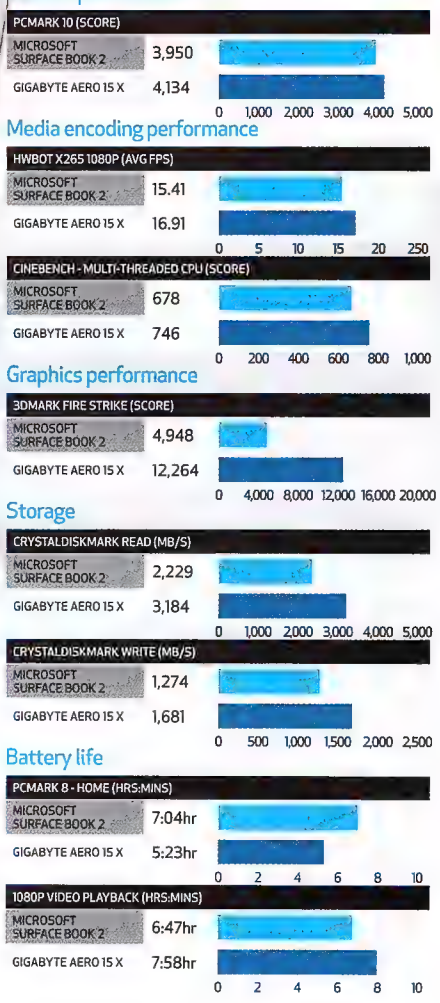
Singing from the same songbook.

LABS BENCHMARK RESULTS


General performance
PCMARK 10 (SCORE)
MICROSOFT SURFACE BOOK 2 3,950
GIGABYTE AERO 15 X 4,134
0 1,000 2,000 3,000 4,000 5,000
Media encoding performance
HWBOT X265 1080P (AVG FPS)
MICROSOFT SURFACE BOOK 2 15.41
GIGABYTE AERO 15 X 16.91
0 5 10 15 20 250
CINEBENCH - MULTI-THREADED CPU (SCORE)
MICROSOFT SURFACE BOOK 2 678
GIGABYTE AERO 15 X 746
0 200 400 600 800 1,000
Graphics performance
3DMARK FIRE STRIKE (SCORE)
MICROSOFT SURFACE BOOK 2 4,948
GIGABYTE AERO 15 X 12,264
0 4,000 8,000 12,000 16,000 20,000
Storage
CRYSTALDISKMARK READ (MB/S)
MICROSOFT SURFACE BOOK 2 2,229
GIGABYTE AERO 15 X 3,184
0 1,000 2,000 3,000 4,000 5,000
CRYSTALDISKMARK WRITE (MB/S)
MICROSOFT SURFACE BOOK 2 1,274
GIGABYTE AERO 15 X 1,681
0 500 1,000 1,500 2,000 2,500
Battery life
PCMARK 8 - HOME (HRS:MINS)
MICROSOFT SURFACE BOOK 2 7:04hr
GIGABYTE AERO 15 X 5:23hr
0 2 4 6 8 10
1080P VIDEO PLAYBACK (HRS:MINS)
MICROSOFT SURFACE BOOK 2 6:47hr
GIGABYTE AERO 15 X 7:58hr
0 2 4 6 8 10

Microsoft's original Surface Book is a couple of years old now, so it's definitely due for a refresh – that's basically what you get with this new model. In fact, at a glance, the Surface Book 2 is nigh-indistinguishable from its predecessor – both 2-in-1s offer a main detachable 13.5-inch (3,000 x 2,000-pixel) tablet alongside a matching keyboard base, which houses a second battery and optional graphics processor.

Although there's new Intel 8th-gen Core i and Nvidia 10-series components here, from the outside, the only significant change is a slightly bigger vent behind the keyboard, as well as a marginally thicker, curvier chassis in this area to accomodate that change, but you'd hardly notice it.

The weight's still about the same (1.6kg), and the feel and build quality are, as before, both amazingly premium. This is still a bit of a niche device, though. Minus the keyboard, the tablet is large and heavy enough that it's hard to recommend for casual users, although for professional, stylus-driven design tasks at a desk, it's undeniably first-rate, with 4,096-level pressure sensitivity making that 13.5-inch screen a lavish digital canvas.

The Nvidia GeForce GTX 1050 GPU in the base means the Book 2 is good for a bit of gaming, but it's really intended for accelerated media rendering and encoding. That combined with the Core i7-8650U CPU in our review unit did help ramp up encoding speeds, giving you about twice the power of what's in, say, the Acer Switch 5 (see right). To get anything beefier, you'll need to go for a thicker (and louder) laptop thanks to the greater cooling requirements.

The battery life lasted 7–10 hours in our tests – helped along by that second battery underneath the keyboard. Without that, the runtime's cut in half, which is still not bad.

The entry-level Core i5/256GB model costs a fairly reasonable $2,199 – but it doesn't include that Nvidia GPU – with three further models on offer, topping out at the $4,499 Core i7/1TB model we looked at. Also of note: the Surface Pen is not included – that'll cost you $140. At time of writing, Microsoft also wouldn't commit as to whether the 15-inch model would be sold in Australia.

There are a few niggling issues here, most of which are carried over from the original. That curved hinge is fairly innocuous-looking when the laptop's open, but when closed, it doesn't compress down as well as a traditional hinge, meaning you're left with a permanent gap between screen and keyboard. Likewise, the tablet is still firmly locked in place until you press a keyboard button to release it – which requires the unit to be powered up. If you're using graphically intensive software, you'll need to close the app or game before the tablet will detach.

Despite this, Microsoft has again delivered one of the best 2-in-1s for pro users – it's a rarity to find a hybrid device that works as equally well in both modes, but the Surface Book 2 achieves it.

Dan Gardiner

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★½

An iterative update to Microsoft's best 2-in-1 brings faster hardware to the same classy overall design.

★★★★½

2-IN-1

$1,499 | STORE.ACER.COM.AU

LABS BENCHMARK RESULTS

General performance

PCMARK 8 - HOME (SCORE)

ACER SWITCH 5	3,279
MICROSOFT SURFACE PRO	3,290

0 1,000 2,000 3,000 4,000 5,000

Media encoding performance

HWBOT X265 1080P (AVG FPS)

ACER SWITCH 5	10.81
MICROSOFT SURFACE PRO	6.58

0 5 10 15 20 25

CINEBENCH - MULTI-THREADED CPU

ACER SWITCH 5	312
MICROSOFT SURFACE PRO	347

0 100 200 300 400 500

Graphics performance

3DMARK ICE STORM UNLIMITED (SCORE)

ACER SWITCH 5	48,683
MICROSOFT SURFACE PRO	71,529

0 20,000 40,000 60,000 80,000 100,000

Battery performance

PCMARK 8 - HOME BATTERY (HOURS:MINUTES)

ACER SWITCH 5	3:23hr
MICROSOFT SURFACE PRO	4:23hr

0 1 2 3 4 5

Storage performance

CRYSTALDISKMARK READ (MB/S)

ACER SWITCH 5	1,532
MICROSOFT SURFACE PRO	1,696

0 1,000 2,000 3,000 4,000 5,000

CRYSTALDISKMARK WRITE (MB/S)

ACER SWITCH 5	594.1
MICROSOFT SURFACE PRO	977.6

0 200 400 600 800 1,000

Acer Switch 5

Acer's aspiring Surface Pro 2-in-1 switches out some high-end specs for a more enticing price.

Whether it's the metal unibody tablet design, the thin folio keyboard case or the 12-inch screen in a 3:2 aspect ratio, the Switch 5 is as similar to the Microsoft Surface Pro as (presumably) patent legislation will allow. But while Acer gets no points for originality, the Surface Pro is a design worth emulating and the Taiwanese PC-maker has done a stellar job making sure this 2-in-1 doppelganger has all the features of its spiritual sibling.

The spec sheets of the 256GB Intel Core i5 version of the Surface Pro up and the Switch 5 are almost identical. At this midrange point, both are built with a 7th-gen Intel Core i5 CPUs, Intel HD Graphics 620, 8GB of RAM and each sports a speedy 256GB PCIe SSD. With such a similar layout, it's natural to wonder why you would ever go for the Acer, but the Switch 5 has one major drawcard – it costs $500 less.

Acer has actually cut costs in clever areas to minimise the performance loss. The most obvious is a slightly smaller screen with a 2,160 by 1,440 resolution to the Surface Pro's 2,736 x 1,824, which definitely makes it less vibrant but doesn't reduce pixel density and picture quality that much. The Acer's i5-7200U CPU is marginally different to the i5-7300U CPU in the similarly specced Surface Pro, so the raw compute scores on Cinebench's multi-threaded and single-core CPU benchmarks are a bit lower on the Switch 5. That said, when the complexities of everyday tasks like those used in PCMark 8's Home benchmark were tested, the difference is negligible with the Switch 5 hitting a score of 3,279 while the Surface Pro punches out a 3,290.

The Surface Pro does outperform the Switch 5 in more GPU-intensive workloads, getting 71,529 to the Switch 5's 48,683 in 3D Mark's Ice Storm Unlimited benchmark. As the Pro is often pitched towards visual creatives, for anyone that does any 3D rendering, this big jump in performance is going to be the fundamental sticking point. While the Switch 5's lower pixel count will mean it drains less battery, it reached an hour less in PCMark's Home battery life benchmark with only 3 hours and 23 minutes.

But Microsoft's offering isn't superior in every way. The Acer's chipset has a better media encoding processor allowing it to get 10.81fps in HWBot's 1080p media encoding benchmark, considerably more than the Pro's 6.58. The Switch also managed to keep the CPU under 81°C across all our benchmarking, a good result considering the lack of any fans (just a bevelled edge that mimics the Pro's vented design).

You're unlikely to notice the difference between the Switch's pen, keyboard and kickstand to Microsoft's, too. On balance, if you're not going to regularly push the GPU to its limits and you can live with a 5-hour battery life, then the Switch 5 is actually a better value offering, but for graphical creatives, then there's enough in the Surface Pro to justify the additional $500 you'll be taking from your wallet. ■ **Joel Burgess**

Verdict

Features	★★★½☆
Performance	★★★★☆
Value	★★★★½

A powerful 2-in-one that sensibly trades off battery life and GPU processing power for a less lofty price.

★★★★☆

apc HOT PRODUCT

"MSI is taking a crack at the living room PC again with another Vortex model... that makes the PS4 Pro look like an oversized alien monolith."

SFF GAMING PC

FROM $2,499; $2,999 AS TESTED | AU.MSI.COM

MSI Vortex G25

MSI's new console-sized PC brings a new desktop performance to the living room.

Although the announcements for the Steam Box and Alienware Alpha made us think that the living room PC might have a future, the lack of availability, expense and the compromise in performance, meant they never really took off. Fast forward a couple of years to 2017, however, and MSI are taking a crack at the living room PC again with a another Vortex model that shifts the attention to consoles and makes the PS4 Pro look like an oversized alien monolith.

Continuing the literage naming convention that started in the Mac Pro-like Vortex GL65, the new G25 manages to squeeze a full-sized PC into a 2.5-litre chassis that weighs only 2.5kg. The 4.5mm-thick unit can be laid flat, propped up vertically with the accompanying stand or even bolted onto the back of your monitor using the standard Vesa mounting system.

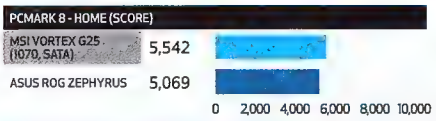
This discrete unit doesn't sacrifice on performance. In fact, it's one of the first units we've seen to feature a six-core Intel Core i7-8700 CPU for a massive uptick in overall computing performance. AMD really put the screws to Intel this year driving them from the incumbent quad-core consumer CPU model it's been peddling for years, to the new Coffee Lake microarchitecture that offers considerable CPU performance boosts.

True to the 'console size, PC performance' tagline that MSI attached to the Vortex, the new CPU and 16GB of DDR4 RAM combine to give one of the highest PCMark 8 Home benchmark scores we have on record at 5,542. This is backed up by the top Cinebench Multi-threaded CPU score of 1,405. The i7-8700 isn't the most expensive CPU of the 8th-generation, but it is a full desktop chip that benefits dramatically from the additional two cores and the efficiencies of a new architecture.

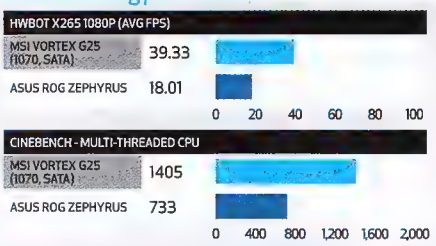
In Australia the Vortex G25 comes in two variations, with the main difference being the GPU and the size of the secondary hard drive. The $2,499 model utilises an Nvidia GTX 1060 6GB and 2TB HDD, while the $2,999 option comes with a GTX 1070 8GB and a 1TB HDD. We tested the latter and netted gaming results that were in line with some of the best gaming laptops available. In 3DMark's Fire Strike Extreme benchmark, the Vortex G25 scored 7,673, a total that was in line with the 7,554 that the ASUS RoG Zephyrus' and its Max Q GTX 1080 GPU managed. Of course, ASUS's Computex sweetheart is anchored by even greater space restrictions and has to run off a battery, but it does demonstrate the GPU power of the Vortex G25, which can get averages of 74.7, 44.5 and 78.8 on the *The Division*, *Ghost Recon Wildlands* and *Rise of the Tomb Raider* on Ultra 1080p settings. Both variations offer a 256GB SSD in addition to a larger HDD for an exceptionally responsive and spacious dual storage setup. We've seen some vendors selling the G25 with NVMe SSDs and others with SATA models, so be sure to go for the former as it won't cost you any more. The size, price and performance of this living room PC is much closer to what we were expecting from the original round of console killers and makes a compelling argument for no-compromise couch-bound PC gaming. ■ **Joel Burgess**

LABS BENCHMARK RESULTS

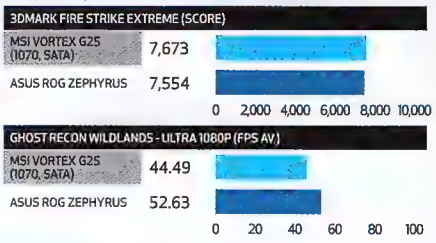
General performance



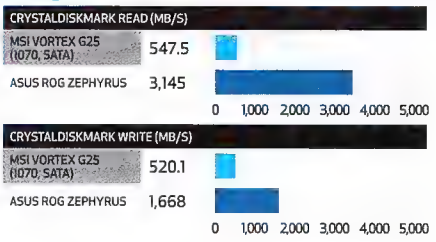
Media encoding performance


HWBOT X265 1080P (AVG FPS)
MSI VORTEX G25 (1070, SATA) 39.33
ASUS ROG ZEPHYRUS 18.01
0 20 40 60 80 100
CINEBENCH - MULTI-THREADED CPU
MSI VORTEX G25 (1070, SATA) 1405
ASUS ROG ZEPHYRUS 733
0 400 800 1,200 1,600 2,000

Graphics performance


3DMARK FIRE STRIKE EXTREME (SCORE)
MSI VORTEX G25 (1070, SATA) 7,673
ASUS ROG ZEPHYRUS 7,554
0 2,000 4,000 6,000 8,000 10,000
GHOST RECON WILDLANDS - ULTRA 1080P (FPS AV.)
MSI VORTEX G25 (1070, SATA) 44.49
ASUS ROG ZEPHYRUS 52.63
0 20 40 60 80 100

Storage

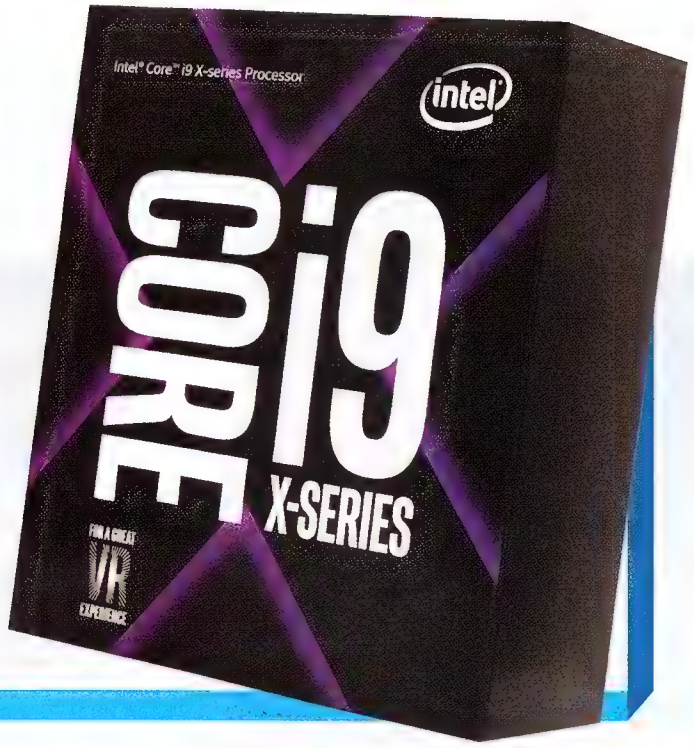

CRYSTALDISKMARK READ (MB/S)
MSI VORTEX G25 (1070, SATA) 547.5
ASUS ROG ZEPHYRUS 3,145
0 1,000 2,000 3,000 4,000 5,000
CRYSTALDISKMARK WRITE (MB/S)
MSI VORTEX G25 (1070, SATA) 520.1
ASUS ROG ZEPHYRUS 1,668
0 1,000 2,000 3,000 4,000 5,000

Verdict

Features ★★★★½
Performance ★★★★★
Value ★★★★

A whirlwind of premium parts and unprecedented performance combine in this powerful living room PC.

★★★★½



GRAPHICS CARD

$799 | WWW.INTEL.COM.AU

Intel Core i9 7960X

Intel has gone core crazy with its Skylake-X 16- and 18-core parts, and we're as happy as open-source pigs in muck.

The 7960X is a sensible alternative to the monster 18-core i9-7980XE. Not to put too fine a point on it, but beyond the Core i9-7900X, it becomes hard to justify buying any of Intel's Core i9 products, especially for gaming.

You still need a good reason to go beyond the base level i7-7800X, or a Ryzen 7 1800X, at least from a CPU performance standpoint. Sure, the additional cores can help speed up video encoding times, and the 7960X has four complete (more or less) i7-7700 chips inside it, but unless you're waiting on your CPU to catch up, you should put your cash elsewhere.

Power use from the Core i9 parts is very high. While there are many elements to total system power draw, we only have equipment to measure total load. Running 'stock', the 7960X uses 369W in Cinebench – and more in other workloads. Likely due to binning, or perhaps motherboard firmware, that means the 16-core part is actually using more power than the 18-core part. That extends to overclocking as well, where the 7960X peaked at 587W versus 576W on the 7980XE.

Stock or overclocked, the gap between the i9-7960X and the i9-7980XE is very small. We measured up to a 10% performance advantage for the 7980XE (when both chips are overclocked and drawing around 500W), but on average, the difference in performance is only 3%. In terms of value, that makes the 7960X a better choice.

If you're wondering how AMD's 16-core Threadripper 1950X stacks up here, the Threadripper ties it in VeraCrypt, with a small lead in zip decompression speed, but overall, the 7960X ends up around 13% faster. It's not a clear-cut victory.

You really don't need this much CPU performance to play games. Even with the fastest graphics card in the form of the GTX 1080 Ti FE, running at 1080p Ultra settings, there's almost no difference between the various Core i7 and i9 processors.

The combination of power requirements, cooling and price make Skylake-X a far more difficult platform to recommend compared to the previous-gen Haswell-E and Broadwell-E. Skylake-X chips are almost always faster, stock or overclocked, but Broadwell-E is more power efficient. If you already own a 6-, 8- or 10-core HSW-E or BDW-E processor, there's no need to upgrade.

We do wonder how long it will be before 16-core processors go 'mainstream.' The first quad-core CPUs, like the $1,700 Core 2 QX6700, were quickly eclipsed by the Core i7-920 after only a few years, and by 2010, quad-cores were pretty common. Eight-core chips have been around in various forms since the FX-8150. With Coffee Lake finally bringing six cores to Intel's mainstream platform, that hurdle may finally fall, but it could a decade or more before 16-core solutions are remotely common.

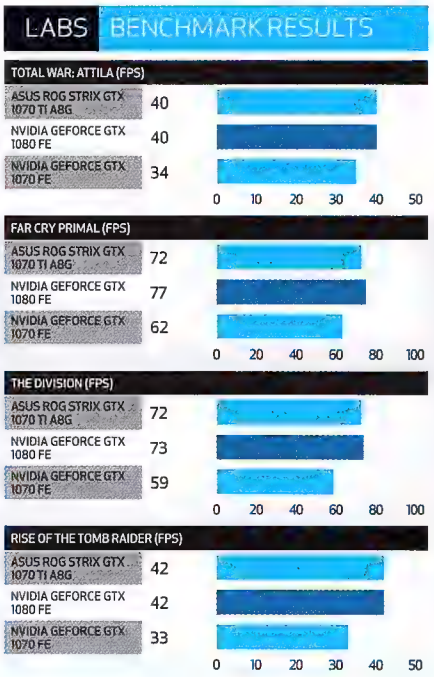
This 16-core i9-7960X earns extra points over the 7980XE for not being quite as obnoxious, but loses some for high-power draw and the lack of prestige that comes from the second-fastest CPU status. We end up with a net tie. Either way, you can rip through high-quality 1080p 60fps video encoding in real-time. Or go for 4K encoding and take your lunch break. ■ **Jarred Walton**

Verdict

Features	★★★★★
Performance	★★★★½
Value	★½

The i9-7960X is extremely potent, but the high price and power demands are tough pills to swallow.

★★★


LABS BENCHMARK RESULTS
TOTAL WAR: ATTILA (FPS)
ASUS ROG STRIX GTX 1070 TI A8G 40
NVIDIA GEFORCE GTX 1080 FE 40
NVIDIA GEFORCE GTX 1070 FE 34
0 10 20 30 40 50
FAR CRY PRIMAL (FPS)
ASUS ROG STRIX GTX 1070 TI A8G 72
NVIDIA GEFORCE GTX 1080 FE 77
NVIDIA GEFORCE GTX 1070 FE 62
0 20 40 60 80 100
THE DIVISION (FPS)
ASUS ROG STRIX GTX 1070 TI A8G 72
NVIDIA GEFORCE GTX 1080 FE 73
NVIDIA GEFORCE GTX 1070 FE 59
0 20 40 60 80 100
RISE OF THE TOMB RAIDER (FPS)
ASUS ROG STRIX GTX 1070 TI A8G 42
NVIDIA GEFORCE GTX 1080 FE 42
NVIDIA GEFORCE GTX 1070 FE 33
0 10 20 30 40 50

GRAPHICS CARD

$699 | WWW.NVIDIA.COM

Nvidia GeForce GTX 1070 Ti

The upper-midrange card that should not be.

Unless you're deep into crypto-currency mining, this generation's GPU war is over. Nvidia has won. Vega, while powerful, can't compete from a price perspective, and thanks to its horrendous power draw and delayed launch, it's not an attractive proposition for gamers. Vega 56 was the most intriguing offering, slotting between the GTX 1070 and the GTX 1080. And that, presumably, is why Nvidia has brought this GeForce GTX 1070 Ti card to market. However, the problem is that, in its eagerness to secure every corner of the GPU market, Nvidia has cut off its nose to spite its face.

Wait, what? The GTX 1070 touts 1,920 CUDA cores, 120 texture units, and 8GB of GDDR5; the GTX 1080, on the other hand, features 2,560 CUDA cores, 160 texture units, and 8GB of GDDR5X. That's a pretty wide gap, especially with the memory configuration. But when you consider that the 1070 essentially equates to a Titan X of Maxwell's generation, it's fair to say that both cards are attractive offerings for anyone looking to game at 1440p or higher.

The GTX 1070 Ti, then, features 2,432 CUDA cores, 152 texture units, and 8GB of GDDR5 — a difference of 128 CUDA cores between it and the GTX 1080. To put that into perspective, the difference between the GTX 1060 3GB and 6GB variants is — yup — 128 CUDA cores. If you've followed us for a while, you'll know we stand by the GTX 1060 3GB as being the better value card, purely because, in our tests at least, the difference between it and its 6GB brother is just 1–2fps, with half the memory capacity.

It should come as no surprise, then, that in our tests, the GTX 1070 Ti and the GTX 1080 perform almost identically, even when compared against some of our more overclock-heavy aftermarket models. The maximum disparity between the two at 1080p was 3fps; 5fps at 1440p; and 4fps at 4K. That's insane when there's about $90–$100 difference in price.

The lines become even more blurred when you enter the realms of over-clocking. There were plenty of rumours concerning Nvidia requesting that AIB manufacturers not produce 'overclocked' variants of its GTX 1070 Ti. And when you combine that knowledge with the fact that there's an 'advanced' sticker covering the word 'overclocked' on our ASUS GTX 1070 Ti box (no, seriously), well, we'll leave you to be the judge of what's really going on. But the fact is, you can easily add 220MHz on to the core clock, and 350MHz on to the memory, without temperature issues, and end up with performance and scores that actually surpass a stock GTX 1080.

So is this just a really dumb overreaction to Vega 56? Well, yes and no. We can sort of see the logic behind the design of the card. Firstly, GDDR5X is expensive to produce and in short supply. Secondly, the GTX 1080 has been out for 18 months now — if you were going to buy one, you would have done so already. What you're getting with this is a GTX 1080 at a discounted price, which kind of makes sense. Nvidia gets to keep the prestigious nature of its product line, without calling it a cut-down or discounted GTX 1080, and at the same time, it shores up that extra acreage of market share. It's a smart move, but if you recently bought a GTX 1080, it's a bit of a slap in the face.

Zak Storey

Verdict

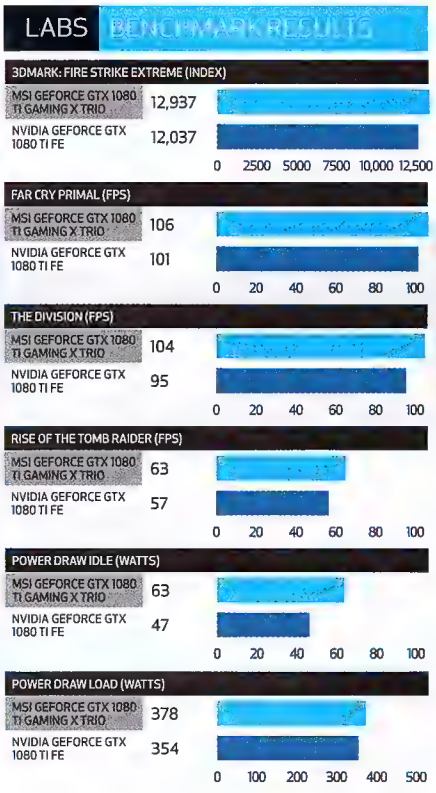
Features	★★★★½
Performance	★★★★½
Value	★★★★½

Impressive performance with good overclock headroom at a tempting price, if you don't already have a 1080.

★★★★½

GRAPHICS CARD

$1,349 | AU.MSI.COM


LABS BENCHMARK RESULTS
3DMARK: FIRE STRIKE EXTREME (INDEX)
MSI GEFORCE GTX 1080 TI GAMING X TRIO 12,937
NVIDIA GEFORCE GTX 1080 TI FE 12,037
0 2500 5000 7500 10,000 12,500
FAR CRY PRIMAL (FPS)
MSI GEFORCE GTX 1080 TI GAMING X TRIO 106
NVIDIA GEFORCE GTX 1080 TI FE 101
0 20 40 60 80 100
THE DIVISION (FPS)
MSI GEFORCE GTX 1080 TI GAMING X TRIO 104
NVIDIA GEFORCE GTX 1080 TI FE 95
0 20 40 60 80 100
RISE OF THE TOMB RAIDER (FPS)
MSI GEFORCE GTX 1080 TI GAMING X TRIO 63
NVIDIA GEFORCE GTX 1080 TI FE 57
0 20 40 60 80 100
POWER DRAW IDLE (WATTS)
MSI GEFORCE GTX 1080 TI GAMING X TRIO 63
NVIDIA GEFORCE GTX 1080 TI FE 47
0 20 40 60 80 100
POWER DRAW LOAD (WATTS)
MSI GEFORCE GTX 1080 TI GAMING X TRIO 378
NVIDIA GEFORCE GTX 1080 TI FE 354
0 100 200 300 400 500

MSI GeForce GTX 1080 Ti Gaming X Trio

Custom-cooled versus Founders Edition versus Titan Xp.

We go through a simple process of elimination when choosing which GPUs to review. Typically, we review a reference card on launch, then, if it's interesting enough, one or two aftermarket variants, and generally, that's it. It has to be exceptional to cover more than that. MSI's Trio is one such card.

Admittedly, this isn't the first tri-cooler we've seen from MSI. So what's so interesting here? Think of this as MSI's equivalent of ASUS's DCIII. Or a Tri Frozr cooling solution, instead of its usual Twin Frozr. Now, the Twin Frozr is still a solid and dependable cooling choice, capable of keeping even the GTX 1080 below 70°C under load in some of the most airflow-restricted cases out there — so why the big push for the triple fan? Well, the general public is under the impression that the more fans you have, the cooler you can keep it, and although that is somewhat true, nothing in our eyes trumps good heatsink design, something at which MSI has always excelled.

The Gaming X variants are now looking to be available to the mainstream at a far more affordable price, and coupled with the GTX 1080 Ti GPU at its core, this is a prime outing for the new cooler. Packed with a fully custom PCB, designed from the ground up for improved power delivery, and the inclusion of RGB lighting, it's easy to see why MSI chose the GTX 1080 Ti as its base for the Trio's first outing. We'd be surprised if the next generation of cards didn't come with Trios as standard, across everything from the GTX 2060 upward.

How good is it, and how much of a difference does that custom PCB make? It all comes down to memory and GPU core clock speeds. In brief, with the help of GPU Boost, in our testing, the Trio's stock performance was exceptional.

At 1440p, we saw average frame rates as high as 106 in *Far Cry Primal*, 63 in *Rise of the Tomb Raider*, and 57 in *Total War: Attila*. The Titan Xp at stock scores average frame rates of 107, 64 and 58, respectively, — that's a one-frame-per-second difference, for a card that costs $600 more.

It's cool, too. While overclocking and running stress tests, we achieved a maximum temperature of 58°C. Impressive at stock, but we weren't anywhere near that, pumping an extra 120MHz into the core and 270MHz into the already overclocked memory.

MSI has really hit it out of the park with this one. The Gaming X Trio is an impressive redesign of an already impressive card, with incredible stock performance and cooling. It's a heavy beast, even coming with its own reinforcing bracket, but the trade-offs are few. To be frank, it's one of the best GTX 1080 Tis we've seen. The big questions are: Can you stomach the $150 price hike for the additional performance, on top of MSI's currently most affordable GTX 1080 Ti ARMOR Edition? And do you mind the slightly off-putting RGB LED lighting design? If the answers are yes and no, respectively, the Trio is likely the best GTX 1080 Ti out there. ■ **Zak Storey**

Verdict

Features	★★★★½
Performance	★★★★★
Value	★★★½

This card has exceptional performance, is quiet and cool, and has an impressive design... if you can afford it.

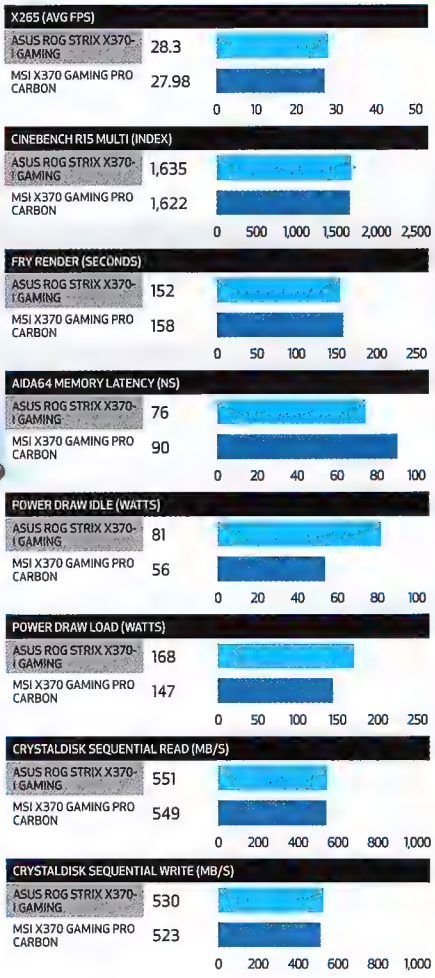
★★★★½

apc HOT PRODUCT

AMD AM4 MOTHERBOARD

$319 | WWW.ASUS.COM/AU

LABS BENCHMARK RESULTS


X265 (AVG FPS)
ASUS ROG STRIX X370-I GAMING 28.3
MSI X370 GAMING PRO CARBON 27.98
0 10 20 30 40 50
CINEBENCH R15 MULTI (INDEX)
ASUS ROG STRIX X370-I GAMING 1,635
MSI X370 GAMING PRO CARBON 1,622
0 500 1,000 1,500 2,000 2,500
FRY RENDER (SECONDS)
ASUS ROG STRIX X370-I GAMING 152
MSI X370 GAMING PRO CARBON 158
0 50 100 150 200 250
AIDA64 MEMORY LATENCY (NS)
ASUS ROG STRIX X370-I GAMING 76
MSI X370 GAMING PRO CARBON 90
0 20 40 60 80 100
POWER DRAW IDLE (WATTS)
ASUS ROG STRIX X370-I GAMING 81
MSI X370 GAMING PRO CARBON 56
0 20 40 60 80 100
POWER DRAW LOAD (WATTS)
ASUS ROG STRIX X370-I GAMING 168
MSI X370 GAMING PRO CARBON 147
0 50 100 150 200 250
CRYSTALDISK SEQUENTIAL READ (MB/S)
ASUS ROG STRIX X370-I GAMING 551
MSI X370 GAMING PRO CARBON 549
0 200 400 600 800 1,000
CRYSTALDISK SEQUENTIAL WRITE (MB/S)
ASUS ROG STRIX X370-I GAMING 530
MSI X370 GAMING PRO CARBON 523
0 200 400 600 800 1,000

ASUS RoG Strix X370-I Gaming

Pure engineering genius.

When Ryzen first launched, the gaudy little underdog pulled the rug out from under Intel's feet with its eight-core masterpieces. But memory issues and motherboard instability caused a lot of problems early on, and the selection of high-end X370 offerings was slim at best.

One form factor that was missing was ITX. And with good reason: Ryzen's a hungry beast. The issue, as is common with ITX, is a severe shortage of space. How do you accommodate such a power-hungry chip in an already limited form factor? There have been workarounds, typically from manufacturers with big budgets, but most of the time, the ITX form factor is avoided for anything with more than four cores.

Finally, though, we have ASUS's RoG Strix X370-I. It's a marvel of engineering. The huge bank of VRM situated next to and above the AM4 socket provides a wealth of voltage balancing, without the need to include a large raised PCB, as in the RoG Impact Intel ITX series. Instead, ASUS has shifted its focus away from repositioning the VRMs to reworking the way it manages less integral mobo components. In this case, the audio and M.2 storage. Yep, that LED heatsink sitting just above the PCIe x16 slot is actually a raised chunk of separate PCB, which houses all the audio componentry, supporting the installation of a single M.2 PCIe SSD. It's also situated above a small heatsink that also cools the PCH chipset. This makes a lot of sense. Typically, to improve audio, 'board manufacturers introduce a polyethylene separator between the audio componentry and the rest of the motherboard's PCB, to reduce interference from electrical signals on the board. The design seen here, where the PCB is entirely separate and raised, is more often found in prosumer-grade DACs, such as the Schiit Gungnir, than in an A-grade motherboard.

Now, we're not saying the audio is going to be that good (there's still an M.2 PCIe SSD on there, too), but it should equate to normal levels of audio quality, while freeing up space on the mainboard for that massive VRM solution.

Performance-wise, the X370-I is a beast. We saw better scores at stock than with any other X370 'board we've tested. Memory latency has plummeted, as well. The only cause for concern we have is with power draw, because it topped our idle figures by 20 watts, and is the second highest motherboard we've tested under load.

But the biggy is overclocking, right? Well, it's a mixed bag. We only managed a stable 3.9GHz on our Ryzen 7 1800X across all eight cores. 4GHz was just too far out of reach, alluding to the fact that, even with all this motherboard magic, ITX still has issues holding higher clocks compared to its ATX rivals.

ASUS's RoG Strix X370-I is, ultimately, an impressive entry point to the Ryzen ITX ecosystem. It does have its flaws, but it's easily the best ITX AM4 board you can buy right now, and for that, we have to applaud ASUS.

Zak Storey

Verdict

Features	★★★★½
Performance	★★★★
Value	★★★★½

Impressive design, brilliant aesthetic, huge feature set and strong memory support, all at an acceptable price.

★★★★½

SSD

$599 | WWW.INTEL.COM.AU

Intel Optane 900P

Intel's latest storage technology, originally slated for 2016, is finally here. So what can it do?

Intel's 3D XPoint encountered more than a few delays – not too surprising for a radically new technology, but we worried that, when it finally arrived, it would underwhelm. In 2015, Intel said 3D XPoint (pronounced 'cross point') would deliver up to 1,000 times the performance, 1,000 times the speed, and 10 times the capacity of traditional NAND. Utilising a x4 PCIe channel limited to 4GB/s, those claims won't be reached yet – but what about the rest?

Endurance is the easiest and most striking example of what 3D XPoint brings to the table. The Optane 900 SSDs are rated at 10DWPD (drive writes per day) for five years. Let's put that into perspective: Samsung's 960 Pro line is rated at 400TBW (terabytes written) for the 512GB model, over five years. That means you could potentially write about 220GB every day, for five years before the NAND gets used up. At 10DWPD, the Optane can manage 2,800GB per day on the 280GB drive for five years. That works out to 5.11PB of data (1PB equals 1,000TB). That's nuts, though the mathematician in us must point out that 5.1PB, while impressive, is nowhere near 1,000 times the endurance – that would be closer to 300PB. That's a whole lot of data, as power users average closer to 10–20GB per day of writes, and casual users may only do 1–2GB per day max.

As for capacity, or at least density, it's early days yet. Current packaging puts 16GB per chip. The largest 3D XPoint SSD is currently the 480GB 900P model; the 750GB and 1.5TB Optane P4800X mentioned early in 2017 have yet to materialise.

Intel is pushing the high performance at low queue depths heavily, and with good reason. Most users won't go much beyond a queue depth of four in normal use, and the majority of storage reads/writes happen at QD1 (queue depth). But to show how much faster SSDs can be compared to HDDs, testing at QD32 is pretty common. Outside of heavily loaded servers, such workloads are firmly sat in fantasyland.

But for those that need more storage performance than a basic SSD, the 900P has that and more. Overall performance is noticeably higher than any other drive: it beats former champion the Samsung 960 Pro by nearly 30%. Under testing at QD1 random read performance, the 900P is over six times faster than its nearest competitor.

The file copy test shows a small gain, sequential write is also up, but other disciplines have the 900P trailing other SSDs. Does this mean that the drive isn't always the fastest? Yes, in a few cases, but in practice, most of the areas where it trails aren't critical, and performance is nearly at the top of the stack. Sequential read speed is the biggest shortcoming, but at 2.7GB/s, few applications will ever exceed that value.

Giving equal weight to all areas of performance, the Optane 900P ends up dominating its closest competitors. But there are downsides, first, there's the price: $599 for 280GB. The best prices for SSDs tend to be around $0.40 per GB. Optane 900P takes things back to $2.14 per GB, which is over twice the cost per GB compared to the Samsung 960 Pro. Cost aside, though, the 900P earns high marks, and we're excited to see what the future holds.

■ Jarred Walton

Verdict

Features	★★★★★
Performance	★★★★★
Value	★★

3D XPoint is where storage is headed, but unless you're a speed junkie, it's not an essential purchase.

★★★★½

MONITOR

$999 | WWW.PHILIPS.COM.AU

Philips BDM4037UW

It's big, yes, but it ain't that beautiful.

PC technology is pretty mature these days, particularly monitors. Usually, even a cursory perusal of the spec list gives you a good idea of what to expect. So it's not all that often a screen comes along and blows apart your expectations, but that's exactly what the new Philips BDM4037UW pulls off. Unfortunately, it does so for all the wrong reasons.

On paper, it looks similar to the BDM4065UC. Its sibling has been knocking around for a few years, but offers the same 40-inch 3,840 x 2,160 UHD native resolution. Both panels also leverage VA technology, and Philips claims similar specs for everything from contrast to pixel response. Indeed, the only really significant difference is the BDM4037UW's curvature.

The curve is an acquired taste, but it's at least a known quantity – a far less agressive angle of 3000R. Its 'new' status, you'd think, would, if anything, provide the BDM4037UW with a more advanced panel, and perhaps some more refined electronics. That would be no bad thing, given the old BDM4065UC had some image quality quirks.

Alas, no. The BDM4037UW is a bit of a disaster. The main problem is what, in this day and age, can only be classified as appalling pixel response. Philips rates the panel at 4ms, versus 3ms for its more elderly sibling. But the gap feels more like a minute than a millisecond. The blurring and ghosting is grim. Unfortunately, ramping up the pixel overdrive setting barely puts a dent in the problem. It's a while since we've seen a VA panel this bad.

Another throwback to the bad old days of VA panels is the overly warm colour temperature. It's the kind of thing you can mitigate to some degree via calibration. But this is far from the most accurate LCD panel on earth, and you're never going to achieve anything really neutral when it comes to temperature and overall gamut. While we're sticking the boot in, the backlighting isn't particularly strong, either.

Plus, that shallowness of the curvature is such that it feels more like a gimmick than a practical feature. It's a big screen, so if you're going to buy into the curved panel proposition, why not really go for it? The viewing angles are mediocre, too. To all that, you can add a chassis and stand that look a little cheap, at which point you're probably thinking the BDM4037UW has no redeeming features. That isn't quite right.

It boasts impressive contrast, with plenty of detail in black and white scales. It also renders virtually perfect, smooth gradients. Moreover, it's still a 40-inch UHD panel, and that means it's absolutely huge, and has literally millions of pixels. Just over eight million, in fact. That means oodles of desktop real estate, tons of detail, and an epic overall visual impact. What's more, most of the time, that sluggish pixel response isn't actually a huge drawback. It's often not even that noticeable in games.

For those who want a very large screen and lots of pixels above all else, the Philips BDM4037UW holds a certain appeal. It's just not a terribly robust appeal in the context of its $999 price tag. To take one example, Philips' sister brand AOC offers the C4008VU8 with virtually identical specs for $150–$200 less. Put simply, there are better options at this price point.

Jeremy Laird

Verdict

Features	★★★½☆
Performance	★★★☆☆
Value	★★½☆☆

Despite its impressive size, it also has an awful pixel response, which isn't great for something at this price.

★★★☆☆

BLUETOOTH SPEAKERS

$149.95 | WWW.LOGITECH.COM/EN-AU

Logitech MX Sound

Affordable Bluetooth speakers.

Logitech's new MX Sound speakers stand just 16cm high and wide, so they'll sit comfortably on either side of your computer without taking up too much desk space. They provide Bluetooth for mobiles, and can pair with two devices at once. And just like the other MX products, the MX Sound enables you to switch between devices – either Bluetooth or wired – quickly and easily. There are also two 3.5mm connectors for audio input.

The one thing missing here is a USB port. Given the speakers' compact design, it would be handy to power them straight from a USB port – especially now that devices such as the iPhone can use a Lightning-to-USB cable to deliver digital audio that provides higher quality than either Bluetooth or a conventional 3.5mm wired connection.

You're not going to get hi-fi quality from speakers costing $150, but the MX Sound does a good job for its size. The speakers produce a warm, full sound with the massed harmonies of Queen's 'Somebody To Love' and manage to create an open, expansive soundstage for the wide atmospherics of Enya's 'Orinoco Flow'. The only disappointment is the bass output. To be fair, the little bass port on each speaker (doubling as a stand) adds some body to the mid-bass on pop tracks, but the small speakers do struggle to get down to deeper, electronic bass lines.

There are bigger, better speakers around, but if you need just a compact set of speakers to enhance music and video on your PC and mobile devices, the MX Sound will do the trick very nicely, without costing the Earth. ■ **Cliff Joseph**

Verdict

Respectable sound quality in compact and affordable stereo speakers.

★★★★☆

NAS BOX

$699 (DISKLESS) | SYNOLOGY.COM

Synology DS418play

Easily stream audio and video on your home network.

The DS418play is the latest in a line of Synology network-attached storage (NAS) boxes that have been designed to stream audio and video to all the devices on your home network.

The DS418play is a 4-bay NAS that can be configured as a RAID array for speed or redundancy. Unlike other Synology NAS boxes, it transcodes video and audio on the fly, so you can store files on its storage drives (not included) and then stream them to an app, such as Synology own video player or the popular VLC.

The DS418play has a faster processor and more memory than its forebears; it supports up to 40TB of storage and can transcode two channels of H.264/H.265 4K video at once. It also supports hardware encryption for file transmission. And it can be used as a destination for Time Machine backups, as well as being a regular file server. Apps enable you to stream audio and video and manage files. With the apps switched on in Share sheets, you can share photos and video to the NAS box. Support for CCTV cameras and direct downloads are also included.

The OS is easy to set up and configure. We had no problems installing storage drives, starting it up, and getting our computer to discover the box on our network. We copied video shot on our mobile to the NAS, and played it back on other devices on the network. We also uploaded audio from a PC and streamed it to our mobile devices. If you want a high-capacity streaming media server that doubles as a NAS all-rounder, the DS418play fits the bill perfectly. ■ **Kenny Hemphill**

Verdict

Transcodes 4K video in real time, is easy to set up and has lots of other features.

★★★★½

GAMING HEADSET

$400 | WWW.BEYERDYNAMIC.COM.AU

BeyerDynamic MMX 300 (2nd-Gen)

The epitome of German utility condensed into a gaming headset.

Originally designed for the aviation industry, the second-gen MMX 300 set is a masterclass in rugged design and uncompromising quality.

Uncharacteristic of gaming headsets, the entirety of these cans is a sedate matte black – everything from the rubberised plastic outer shell to the microfibre coating on the earcup-padding is deliberately inconspicuous. Many aspects of the tank-like construction are similarly utilitarian, such as the detachable and durable cabling, and the replaceable earcup and headband cushions. The audio from the microphone is clear and, although we'd usually appreciate the ability to detach our mics, this unit's fixed design is very easily stowed away.

The earcups are massive, providing an impressive sense of space when gaming, and thanks to the snug fit and firm foam cups, the passive noise isolation is some of the best we've heard. While the frequency response and spatial clarity is well-suited to gaming, we feel that the overall sound could have done with a little more bass love. The acoustics are a touch too flat for a lot of music, and likely won't be able to act as an all-in-one solution for the music-obsessed gamer.

An extra, longer cable, a 1/4-inch plug adapter and a soft-shell carry case push the premium image; however, at $400, this is well into expensive territory. But if you consider the near-invincible build quality and replaceable components, investing in the MMX 300 is likely going to pay off over time.

■ Harry Domanski

Verdict

While the price is high, the quality and durability of this headset will keep gamers happy for years.

PRESENTATION REMOTE

$199 | WWW.LOGITECH.COM/EN-AU

Logitech Spotlight Presentation Remote

The ultimate in presentation.

The Spotlight Remote is an incredibly specialised and powerful tool for presenters. The small remote is home to three adjacent buttons – Next, Back and Pointer – as well as a nook at its base that houses its USB Wi-Fi dongle when not in use (or you're connected via Bluetooth). That's pretty much the extent of the physical features, and this minimalism, plus its aluminium finish, lends it an Apple-esque aesthetic.

Logitech's intuitive Presentation software makes configuring the remote incredibly simple, even with deeper settings and tweaks, and it's compatible with all the major presentation programs across both Mac and Windows platforms such as PowerPoint, Keynote and Google Slides. You can assign secondary functions (activated via long-press) to each of the three buttons, such as fast forward, volume control or scroll. The latter two use the same stable motion-tracking that allows you to use the device as a pointer and cursor when holding the top-most button.

While the battery life is impressive and the remote has clever power-saving features, the USB-C recharge speed is the real showcase. A single minute of charging offers a full 3 hours of use, while a full charge (around an hour) allegedly keeps the unit powered for up to 3 months.

The price may seem a little steep for a glorified button-stick, but the attention to detail and feature-set make this a must-have for anyone that regularly finds themselves standing between a slideshow and a tough crowd. ■ Harry Domanski

Verdict

For those looking for the only presentation remote they'll ever need, this is well worth the price.

apc RECOMMENDS

NAS BOX

16TB, $1,149 | WDC.COM

WD My Cloud Home Duo

Large-capacity storage in a stylish, convenient package.

WD My Cloud Home combines high-capacity, cloud-connected storage in an easy-to-use package. No more paying monthly fees to upload gigabytes of content over poky internet connections – storage is located inside your home or office, available from anywhere just by plugging the included Gigabit Ethernet cable into your router.

Unlike single-drive models, My Cloud Home Duo houses a pair of hard drives in a handsome, relatively compact package, with capacities ranging from 4TB to a huge 16TB. Duos are configured RAID1 by default, which cuts storage space in half but offers data protection when one drive fails. You can also reformat and trade security for maximum storage capacity.

The unit gets a bit noisy during read and write activity, though, so you'll want to place it away from your desk.

> "Unlike single-drive models, My Cloud Home Duo houses a pair of hard drives in a handsome, relatively compact package, with capacities ranging from 4TB to a huge 16TB."

My Cloud Home takes only a few minutes to set up, and with WD Discovery for macOS or Windows installed, it mounts on the Desktop like other volumes. There's an on-the-go mobile app (called My Cloud Home) for automatic backup of photos and videos or viewing content from anywhere, but the lack of native tablet support is a bit of a disappointment.

Considering the network connection, transfer rates are impressive: Around 90MB/s for reads and 60MB/s for writes, fast enough to play 1080p HD video. This comes in handy when using the included Plex Media Server app, which streams content to devices without a WD app.

There's also an app for connecting cloud storage services and social networks, which syncs files to your personal cloud, as well as IFTTT for incorporating My Cloud Home into other workflows. You can also get your hands on Google Drive and Dropbox apps. The available apps for download pales in comparison to true NAS devices, however.

Each user on the NAS can set up their own private space with exclusive access so that they can manage their content in private, protected by a password and/or biometrics for access from a mobile iOS or Android device.

The device itself also includes two USB ports to directly import media from an external storage device. And the whole package is just 17.9 x 16 x 10.2cm.

In all, personal cloud storage gets a big upgrade here, thanks to dual hard drives that provide valuable peace of mind. The Home Duo is easy to use and looks great anywhere.

■ JR Bookwalter

Verdict

Features	★★★½
Performance	★★★★
Value	★★★★

Easy to set up and use, syncs cloud storage and looks great, but has limited apps and is a bit noisy.

★★★★☆

"The P300 is one of the most exciting cases we've looked at recently. An $85 chassis, with a feature list longer than Kim Jong Un's dinner menu."

apc HOT PRODUCT

PC CASE

$85 | WWW.PHANTEKS.COM

Phanteks Eclipse P300

The budget gods are pleased by this feature-packed PC case.

There's an expectation when shopping for a case on a budget that you're going to end up with a bum deal. If you're looking around the $80–$90 mark, the likelihood of finding one with anything resembling modern-day features is slim. Want cable management, a PSU cover, extensive radiator support, fan mounts and tempered glass for less than $150? Get outta here!

The notion has always been that, cases being the least important part of any budget build, you should forsake the fancy features, and just get whatever's available with the funds you have left after buying everything else. After all, cases are all pretty much the same at this price point.

That's why the P300 is one of the most exciting cases we've looked at recently. An $85 chassis, with a feature list longer than Kim Jong Un's dinner menu.

One glance at its design, and you can easily spot the PSU cover and the tempered glass side panel. But it's only once you begin building in it that the true depth of Phanteks' innovation begins to shine through. With 280mm AIO support in the front, including space-saving dust filters, located top and bottom, the forward-facing panel provides two front-installed 3.25-inch caddies for all your typical hard drive needs. Remove the rear side panel, and you'll find a single Phanteks 2.5-inch caddy for SSDs mounted to the back of the motherboard tray, and oodles of cable management room, as well. There's a metal cable cover, too, not entirely dissimilar from the one in NZXT's S310 case, yet coupled with Phanteks' championed Velcro straps, of course.

And then there's the included lighting. Fully compatible with any of your after-market RGB synching technology from the likes of ASUS, MSI, Gigabyte and so on, you do need to invest in the cable to integrate it. Combine all that with support for up to E-ATX motherboards as big as 275mm in width, and it's hard to complain.

There have to be drawbacks, right? Well, yes, there are a few. Firstly, the material used – it's a basic steel chassis at heart, making it somewhat flexible, and the paint job seems to attract greasy fingermarks. On top of that, there are no rubber grommets included, no GPU power cut-out in the PSU cover, and only a single 120mm fan installed at the rear of the chassis. Our biggest gripe, however, lies with the HDD caddies. Admittedly, we did decide to stick a 2TB WD Black drive in there, but the mounting holes in the toolless design simply didn't support our drive, and we had to physically remove them from the caddy, then mount the hard drive with screws before installing it.

Ultimately, the Eclipse P300 is an astonishing feat of cost-cutting ingenuity. To find a case at this price point, packing so many modern design features, with so few drawbacks, is staggering. We'd love to see some other colour variations in the future, and perhaps a V2 or a Pro line for $20 more that addresses our HDD issues and the lack of rubber grommets and GPU cut-outs.

But that aside, it's perfect for anyone looking to build a brand new budget rig. It's a chassis that should sell well, and encourage other manufacturers to rethink what they include in their budget offerings. The P300 is to cases what Ryzen was to processors, and for that, we can't credit Phanteks enough.

Zak Storey

Verdict

Features	★★★★½
Performance	★★★★☆
Value	★★★★★

This PC case packs in more than your usual budget offering, making it an excellent option.

★★★★½

apc HOT PRODUCT

"The resolution levels of Logitech's Hero sensor can be minutely customised between 200 and 12,000, and all the relevant settings are stored within the mouse itself."

WIRELESS GAMING MOUSE

$99 | WWW.LOGITECHG.COM/EN-AU

Logitech G603 Lightspeed Wireless Gaming Mouse

Another understated wireless wonder.

Logitech's Lightspeed gaming mouse is the result of refinements of every component in the wireless signal chain, from antenna geometry to circuit pathways to communications protocols. All of this results in a reported 1ms response time and absurdly long 18-month battery life.

Not both at the same time, though. You'll only get that length of service from the G603's dual AA batteries if you switch it to low response mode, via the base-mounted switch. This drops the polling rate from the full 1ms to a still-reasonable 8ms and, as you might expect, this has a noticeable effect on the mouse's DPI. Keep it in hi-res 1ms mode, and Logitech suggests you'll get around 500 hours of gaming out of it – still very respectable, but as this lacks the rechargeable internal battery of its more expensive siblings, you'd better have cells on hand when time's up. Switching those batteries is quick and easy – pull up on the magnetic upper shell, and the whole thing comes off, revealing the Omron upper switches and battery compartment within.

It also reveals the vast amount of engineering know-how that's gone into the G603 – the levered buttons, which contact the microswitches at the same time they meet the solid braced frame of the upper shell; the precisely placed neodymium magnets, matching with fine steel screws for just the right amount of attraction; and the internal slot for stowing the minuscule USB receiver while on the move. For an unassuming grey mouse – with just one tiny RGB LED, that you'll rarely see, and nothing else in the way of bling – this is something of a secret winner.

Even the stuff that you can't see is pretty sharp. Every button, including the DPI toggle, can be configured and switched around. The resolution levels of the Hero sensor can be minutely customised between 200 and 12,000, and all the relevant settings are stored within the mouse itself, meaning you can take it to a machine without the Logitech software suite on board. It's easy enough to use the G603 with multiple machines, too – it supports Bluetooth as well as Lightspeed, quickly switchable via a button on its underside.

There are a couple of holes we could pick. The G603's slightly bulbous right-hand-only curve isn't quite as comfortable for palm grip as we might have liked, and its ratcheted wheel doesn't have the same smooth bump as some of its competitors. Had the side buttons been a few millimetres lower, they might have been more quickly accessible, although sitting directly above the natural grip position means it's possible to accidentally activate them. And that price may be too steep for a mouse so plain, in your eyes.

But those things aside, this is easily responsive enough for gaming, resilient enough for years of desktop use, and flexible enough for multiple machines. We think it's worth the price. Lightspeed connectivity is sharp enough that it has to be at the top of your list of requirements if you're considering new wireless peripherals, and the G603 is a reasonably cost-effective way in. ■ **Alex Cox**

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★★★

This mouse has a great and awesome battery life, as well as fast wireless response. Invest in it, we say.

★★★★½

Windows SOFTWARE

IObit Advanced Care

A great PC cleanup and maintenance tool with a security-focus.

~$26 PER YEAR | WWW.IOBIT.COM

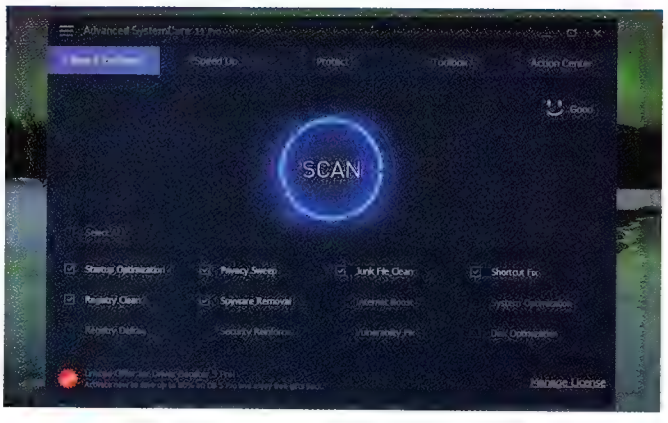
IObit Advanced SystemCare 11 is a system cleaner that checks for startup items, privacy traces (such as typed URLs and other stored history records), junk files, invalid shortcuts, registry entries and spyware threats using its system scanner.

Deep scans do take a while – particularly the first time – so you'll likely prefer to have the unwanted software automatically purged, but you do have the option to set up clearance protocols before the app actually makes changes to your PC. For truly fuss-free cleaning, Advanced SystemCare can shut down, hibernate or send your PC to sleep once it's finished.

The Turbo mode disables some non-critical services and applications that run in the background, including the Windows Font Cache and Device Association Service. This can be handy if you're working on something simple, but if you're installing new software or devices, keep it turned off.

One of SystemCare's new features is Security Reinforce, which helps protect your privacy by checking for system vulnerabilities and alerting you if a program attempts to change your homepage. There's also an ad-blocking tool. You can install the Internet Explorer and Firefox versions of the latter with a single click, but the Chrome edition requires a quick trip to the Chrome Web Store.

There are several thoughtful little touches that make Advanced SystemCare stand out. For example, many modern PCs have SSDs, which don't benefit from defragging (it can actually reduce their lifespan), so although Advanced SystemCare includes a defrag tool, we appreciate that it's not activated by default.



Unlike some system cleanup and optimisation tools we've tried, IObit Advanced SystemCare always gives you a full description of all the files it's removing, and programs and services it's suspending. We appreciate this transparency, and the opportunity to uncheck anything. We like it paired with IObit Uninstaller to keep our review PC free of junk after testing free software, which often comes with additional bits and pieces bundled-in that can prove tricky to remove using Windows' built-in tools. **Cat Ellis**

WPS Office Free – Writer

A word processor with cloud storage and support for all text files.

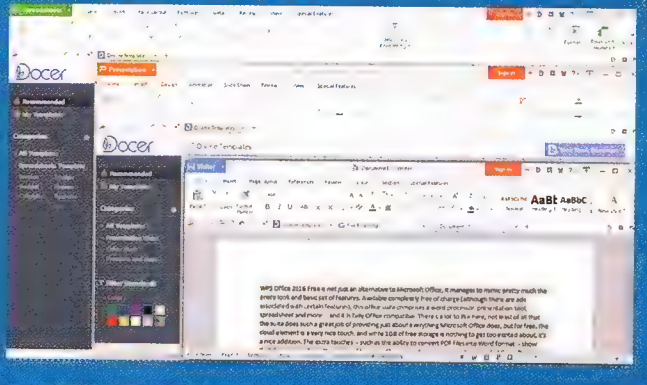
FREE | WWW.WPS.COM/OFFICE-FREE

If you've used a modern version of Microsoft Word, there'll be no learning curve when you switch to Writer – the word processing component of WPS Office Free.

This free word processor looks and behaves almost exactly like its premium counterpart, and even has its own equivalent of OneDrive, offering 1GB free cloud storage.

Its selection of pre-installed templates gives you everything you need for common document types, and you can easily create your own for bespoke tasks. It's compatible with every text file format you can think of, including current and legacy versions of Microsoft Word dating back to Office 97.

WPS Office Writer is supported by discrete ads, which can be removed by upgrading to the premium version, but they're barely noticeable and no features are locked behind a paywall.



Overall, WPS Writer is very impressive, and in our opinion, it's the best free word processor for Windows available to download today.

WPS recently launched a free PDF-to-Word converter, as well, which is a great companion to its word processor. **Mark Wycislik-Wilson**

Carbon Copy Cloner 5

Still the easiest way to create bootable drive clones on Mac.

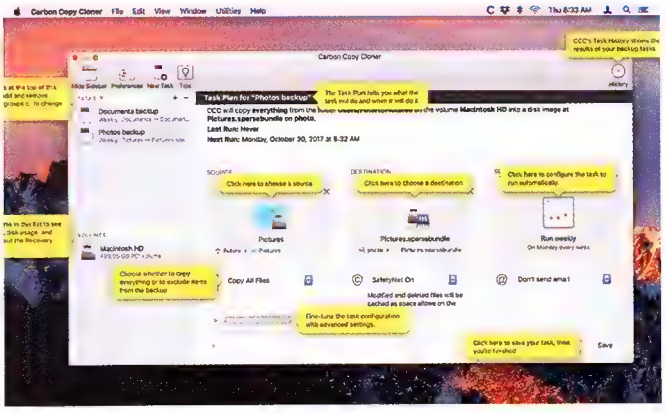
30-DAY TRIAL; $55 | BOMBICH.NET

There are many reasons why you'd want to create a bootable clone of your Mac's startup drive – or any other connected drive. Perhaps you're performing a clean install of macOS, for example. Or simply deleting or overwriting large amounts of data. In each case, a bootable clone can get you out of trouble should something go disastrously wrong.

Carbon Copy Cloner does much more than create bootable clones, but that remains its core function. And if you're using High Sierra, Carbon Copy Cloner supports both the new OS and APFS.

New features in CCC 5 include a guided restore function that offers to walk you through the process of restoring files when you boot from a CCC backup. The Cloning Coach is also new. It watches in the background as you configure tasks, alerts you to any potential problems, and gives advice on how to avoid them.

The other new features in CCC 5 are focused on managing tasks. An Outlook view displays tasks in a calendar format that makes it easy to see which ones are scheduled to take place. Tasks can also be organised in groups.



Aside from its utility, perhaps the best thing about Carbon Copy Cloner is its interface, which is logically laid out. There is room for improvement: sometimes, tips can be displayed beyond the edge of the screen and, with no way to resize the CCC window, the only way to see some of them is to drag the window around.

Despite its few caveats, however, Carbon Copy Cloner is an excellent tool. Cloning your Mac or backing up specific folders has never been easier.

Kenny Hemphill

Keyboard Maestro 8

Keys to productivity.

$55 | KEYBOARDMAESTRO.COM

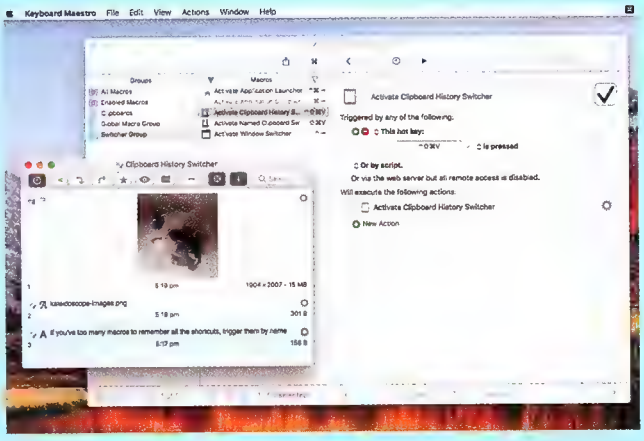
Keyboard Maestro is a macro app used to "conduct your Mac like a pro". You define trigger and action pairs, and then let rip.

What differentiates Keyboard Maestro from the competition is its far-reaching capabilities. Although you can simply set a key to open a folder, to do so is a waste.

The app bundles initial macros to examine, which provide a taste of its true power. For example, when you trigger 'Paste Selection Into Last Application', it copies a selection, switches to the last used app, pastes and then switches back. A moment of thought should result in countless other time-saving macros you could set up.

Chances are, you'll be able to. Keyboard Maestro updates are primarily about more triggers and more actions — and version 8 is no exception.

You can now send messages, get URLs, and prompt for list selections. New triggers include your Mac idling, or headphones being plugged in. Gesture triggers make an appearance, although as drawn squiggles, sadly, rather than swipes and taps. A rare disappointment in an otherwise impressive and powerful app.

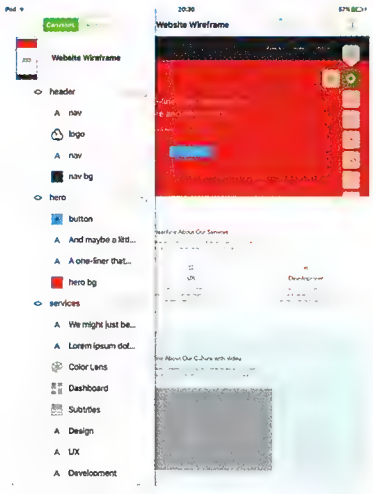


If you want a flexible and powerful macro tool, this is the best around. **Craig Grannell**

OmniGraffle 3

The premier iOS diagramming app just got better.

FREE WITH SUBSCRIPTION | OMNIGROUP.COM



Testament to OmniGraffle's versatility is the software's incongruous collection of fans. Website wireframers, illustrators and process flow junkies all praise its unfussy approach to diagram creation.

OmniGraffle 3 for iOS remains delightfully straightforward. You drag elements to its canvas from a built-in collection of shapes and objects called stencils. The choice is extended through a link to Omni's online stencil repository.

The obvious change is a fresh, panelled look. A lot of usability is packed into the unified navigation sidebar that gathers document objects, layers and canvases. It makes it easy to select objects based on their properties. Each OmniGraffle shape, line or symbol is endlessly adjustable through the Inspector sidebar; once a pop-up panel, this is now static. Fewer taps are needed to adjust properties, but it feels awkward to see the Inspector button along the document toolbar.

Sidebars on iOS devices are inimical to diagramming apps that thrive on space. But OmniGraffle alleviates this through a floating Tool palette that can be minimised with a tap, while tap-and-hold triggers fullscreen mode leaving only the canvas visible.

The canvas dimensions themselves are no constraint now. At any time the canvas can be flexibly extended or made infinite, so you'll never see the canvas edge.

If you're used to OmniGraffle on the Mac, you'll enjoy a near-frictionless transition. However, each version of OmniGraffle on iOS gives more reasons to rely on it as a standalone app. This version can import SVG images and Omni has squeezed in a cross-platform JavaScript engine to manipulate documents through scripts. The Pro version — which adds extras such as Microsoft Visio export — includes a scripting console.

There are still features we'd like to see — a variation of the macOS version's outliner, which accelerates layout creation, for example. But the Freehand tool here compensates: draw a shape on the canvas with your finger and OmniGraffle converts it into an object.

A word too for Omni's 'try before you buy' approach. You can download the app for free, try it for a limited time and upgrade to the full standard or pro versions via IAPs. If you choose not to upgrade after the 14-day trial, OmniGraffle 3 will switch over to a read-only viewer mode, where you can share or view any documents you created during the trial. **Tom Gorham**

SoundShare 3

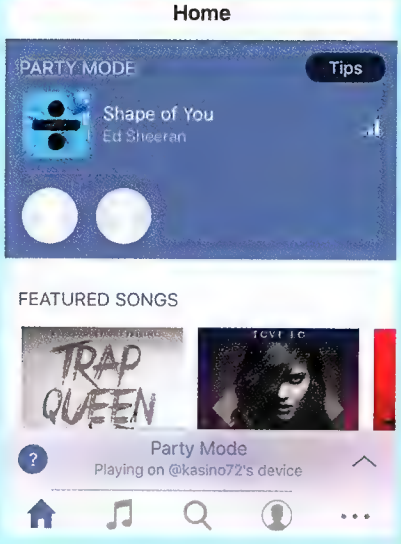
Simple and clever music sharing.

FREE | SOUNDSHAREAPP.COM

From the home-made compilation tapes of the '80s to today's shared links from Apple Music and Spotify, one of the great joys of music is sharing your discoveries or favorites with others. SoundShare was designed to do just that, and to do so in a way that made sharing as easy as possible — it doesn't matter if you're on Apple Music and your friend is on Spotify or Deezer; SoundShare finds the right song in the appropriate service.

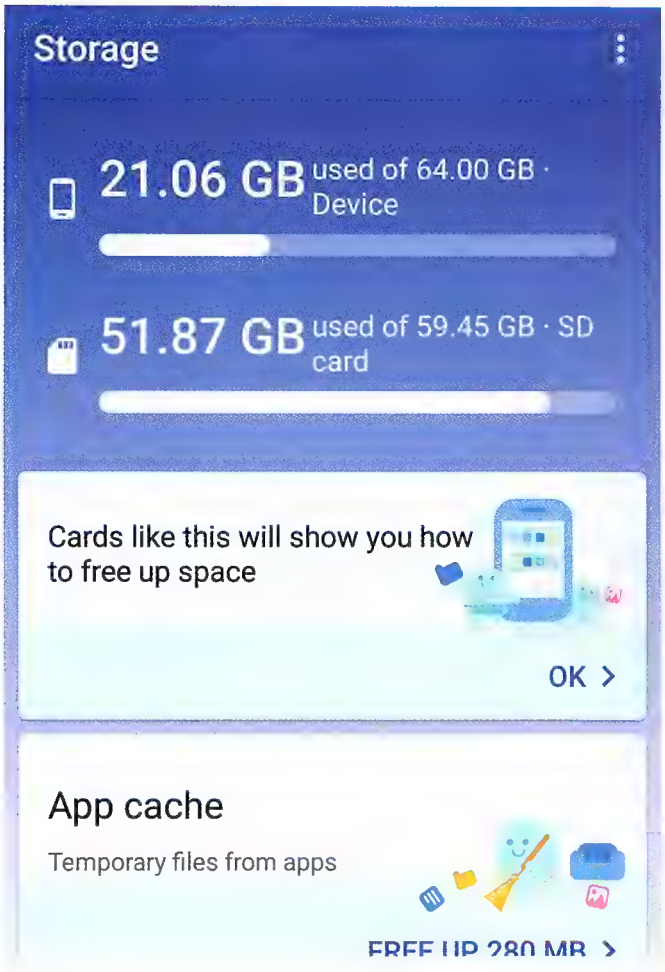
Version 3 has two key improvements. First, it uses MusicKit, the iOS 11 framework that enables deeper integration with Apple Music. This means apps such as SoundShare can access personalised playlists and recommendations in much the same way the Apple Music app does. Second, and even more fun, it has a Party Mode.

With Party Mode you can invite friends to collaborate on a playlist. It's best for — you guessed it — parties, where a single iOS device can handle everybody's requests and send to a wired or wireless speaker system. No more pairing multiple devices, swapping cables, or worse, giving others your passcode. It works really well, although the ability to let others interrupt playback with their own choices could be a problem if any of your friends are impolite and have terrible taste in tunes. In a nice touch, SoundShare can even stream Party Mode videos to Apple TV by finding them on YouTube.



There are a couple of caveats. Spotify sharing doesn't work with the free version of Spotify; you need to have a Spotify Premium account. SoundShare can work only with what's available, so differences between streaming services' catalogs may prevent you from sharing the odd track between two different music services. You can't share with anybody who doesn't have the SoundShare app, so Android owners are not able to take part in Party Mode. And we encountered the odd bug, such as when the Invite option trapped us in a Contacts page. But overall SoundShare 3 is a clever and effective way to share music with friends.

SoundShare 3 makes music more social, and Party Mode is good fun. **Gary Marshall**


Storage
21.06 GB used of 64.00 GB · Device
51.87 GB used of 59.45 GB · SD card
Cards like this will show you how to free up space
OK
App cache
Temporary files from apps
FREE UP 280 MB

Files Go

Android's answer to AirDrop needs more work.

FREE | GOOGLE.COM

Android users generally have it a lot better than iOS users when it comes to the flexibility of moving files around, but it doesn't have a simple alternative to AirDrop. Until now. Files Go is Google's answer to that Apple functionality, and according to the beta version we tested, they're on the right track.

When you boot up the program, you'll find an application hell bent on helping you clear up hard drive space on your phone, but tucked away in there is the ability to share any file – big or small – with a close fellow Android user via a Bluetooth connection that the app itself sets up. Of course, the person you're either sending to or receiving from will need to install Files Go too, but it's a simple affair and, given it's from Google, it'll sync straight with your remaining account without any fuss about logging in or registering. The app is currently a bit on the unstable side – it crashed a half-dozen times during the half hour we used it – but once these are ironed out, it'll be very useful. **Shaun Prescott**

Notification History Log

A nifty way to keep tabs on your notifications.

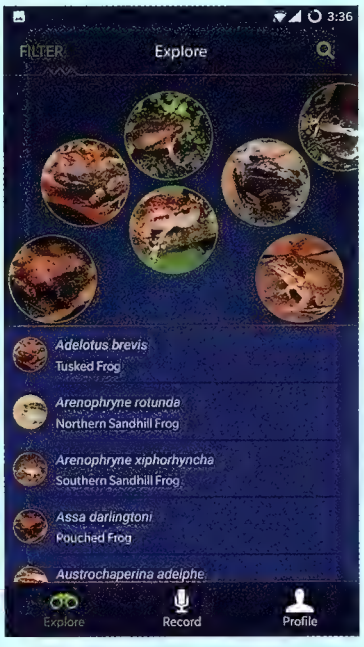
FREE WITH IAP | WWW.GEEKDASHBOARD.COM

We've all been there: clearing out all your phone's notifications that have piled up over the day, but you notice too late that there was one you didn't recognise. What was it about, and which app was it even from? The aptly-titled Notification History Log is here to put an end to the mystery. The standard Notification History screen allows you to view a list of all your notifications and which app they came from, a list that is kept on Android systems but is hidden by default. Tapping on any one of these items will display more detail about the notification, such as its priority, contents, and settings such as whether it will vibrate or play sounds when receiving that type of notification. There's also an Advanced Notification History which will allow you to open the notification directly, and with the purchase of the Pro version, allow you to keep an unlimited amount of stored notifications, and delete them as you please. **Harry Domanski**

FrogID

Learn about frogs and save Australia!

FREE | FROGID.NET.AU



The latest in citizen science comes in the form of the FrogID app, an initiative designed to help count and locate the amount of frogs residing in Australia by focusing on each user's local amphibians. As the app's website suggests, "frogs are a sign of a healthy environment, but around Australia, frogs are declining and many are endangered". Once you've registered an account, you can record the local frog calls in your area and submit them to the national frog count. Eventually, they'll be identified by 'Audio DNA' experts from the Australian Museum and you'll get to know which little frogs live in your area, but more importantly, these experts will be able to get a much better understanding of environmental trends such as the spread of the pestilent cane toads or the flourishing of the striped marsh frog. As motivation to use the app, you'll also be given access to an Explore tab that offers up plenty of detailed and interesting info on all the frog species that people have located so far. **Harry Domanski**

Audacity

Record and edit your sounds.

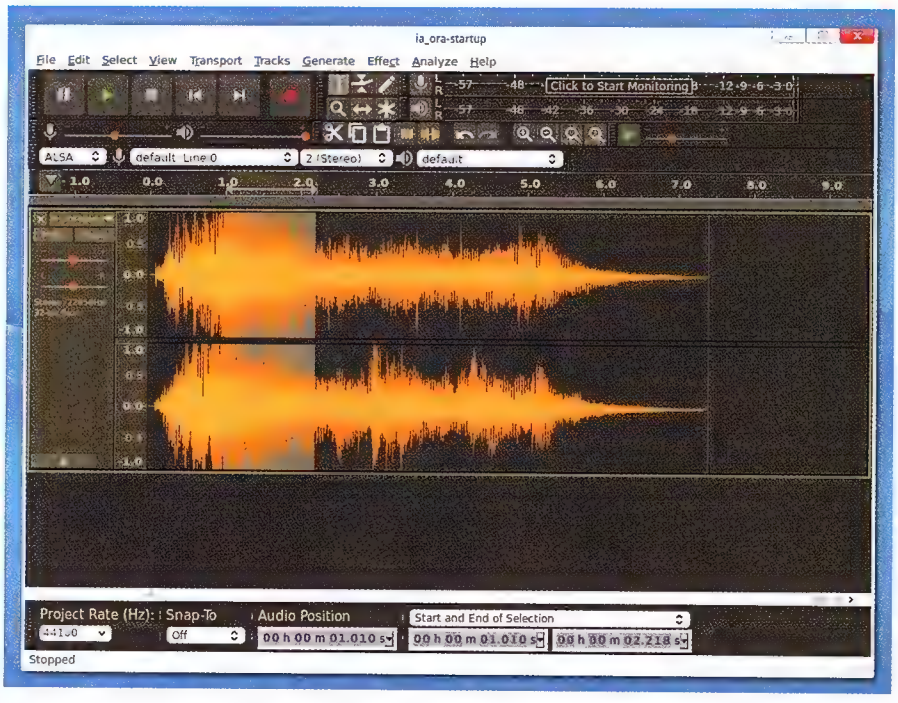
WWW.AUDACITYTEAM.ORG | FREE

We'd love to write about Audacity more frequently, but new releases of this sound editor only occur once every couple of years, if that. The program is one of the most valued and useful open-source apps: it wouldn't be much of an exaggeration to say that Audacity is the go-to free sound editor, much like Gimp is the first choice for editing images.

It can be used for recording with a mic, overlaying two or more sound tracks, mastering podcasts, removing periods of silence, splitting a large recording into several files, normalising volume, reducing noise and re-encoding wave data into a different file format. Yet these features are just a small part of what Audacity has to offer.

We've had to wait over two and a half years for this latest version, while the major 2.0 release came out way back in March 2012. Version 2.2 brings nearly 200 bug fixes and small improvements, so let's take a quick look at some of the more notable and visible changes.

The first one is the addition of three new themes to the classic Audacity look (the one with round, bevelled buttons).



By default, the editor now uses a modern light theme, but you can change it to Dark, or High Contrast, or create your own custom theme. Under the hood, Audacity now recovers more sound data in case of severe system freeze or brutal shutdown. It also supports MIDI files playback, once you set up a MIDI software synthesiser such as TiMidity++, and boasts a revamped user manual with plenty of updated tutorials.

All in all, the new Audacity 2.2 is a highly recommended update for existing users and a handy 'just in case' tool for everyone else. Converting old tapes, as well as editing WAV, AIFF, FLAC, MP2, MP3 or Ogg Vorbis sound files is best done with this application.

The new release is expected to hit repros of major Linux distributions soon, but the team's site contains some binary packages that are available right now, if you're keen to try it out.

Alexander Tolstoy

Outwiker

A place to chuck all your notes

BIT.LY/OUT-WIKER | FREE

Placing electronic files and documents in order is as important as keeping your house tidy. Those Linux users who have a large number of documents inside their ~/ directory know that manual sorting can be tedious unless you have a well-designed program at hand. The application we'd like to bring to your attention is a direct competitor to the desktop Evernote client (sadly still missing for Linux) or Cherrytree.

Some people advocate the use of dedicated software instead of the proven combo of a text editor and a file manager. Once you've amassed a collection of notes, web pages, text snippets, images and other file types, you need a tool that can pull them all together and enable you to navigate them with ease, edit, sort, tag and find what you need. Such tools often use a tree hierarchy for navigating and are referred to as outliners. The distinctive feature of Outwiker is that your tree of pages is saved as a plain structure of files and directories inside your home directory. Outwiker doesn't hide your library inside a single file or a database, and this means you can edit your notes with other programs, sync them via any cloud services and then continue to use and maintain your library with Outwiker.

The Notes panel on the left is a core part of the interface. Here, you create a top-level root element and add child subpages to it. Outwiker supports plain text, HTML and Wiki types for pages with content, and also a special Search type for carrying out search queries across other pages.

Editing a page resembles working in a WYSIWIG web composer, where you can play with rich text formatting and then seen how the page is rendered and what its HTML code look like. Outwiker enables you to use the same markup language as that of Wikipedia, making it possible to create your own local Wikipedia-styled knowledge base, with tags, bookmarks and external attachments. It's a very capable and mature piece of software, written with Python and available for Ubuntu via `ppa:outwiker-team/ppa`. **Alexander Tolstoy**

2018 TECH PREVIEW

Twelve months is all it took to see revolutionary change in the tech industry. With the race to greater core counts in mainstream processing, the release of Intel's Optane SSD drives, Ethereum mining pushing up GPU prices, and more, 2017 was a particularly interesting year. But that's in the past, and 2018 is the future, so what do the next 12 months look like? It's time for us to sift through the hype, and get down to the nitty-gritty of what is going to make 2018 great.

REFINING SUCCESS

Intel may be rattled, but AMD needs to cement its success with revision.

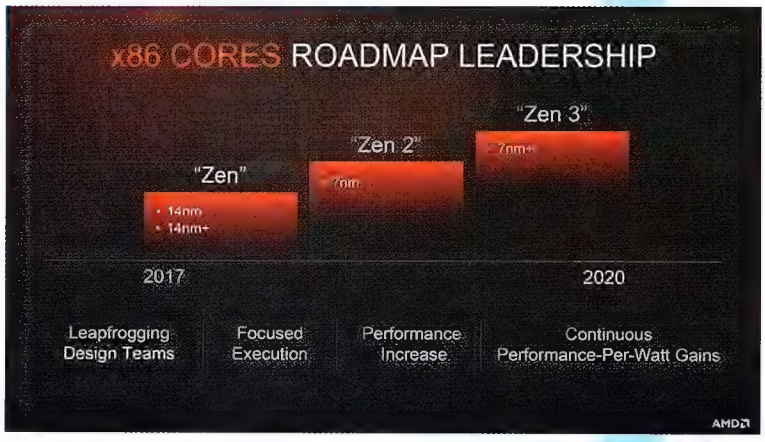
It's a rare occurrence for the hype train to be not quite as overwhelming as the potency of the product it represents. And with Jim Keller masterminding the development of Team Red's latest architecture, AMD's Zen CPU lineup was hardly going to be a dud. However, none of us truly knew what to expect from the company that had otherwise disappointed us on the computational front for the previous six years.

Ryzen was, and still is, a masterpiece. A once-in-a-decade reinvention of a product. Something that AMD so desperately needed in order to assure its own future. Its effect on consumer computing has been vast and far reaching, pushing Intel to act, stop resting on its laurels, and raise its core counts higher, if only to retain anything like the market share it once had. And, at last, after six long years of waiting, there's finally a choice – consumers actually have a decision to make once again. Both processor manufacturers now provide options more than capable of succeeding the platforms of yesteryear. Whether it's Skylake X or Threadripper for workstations, Coffee Lake or Ryzen 7 in the mid-range, or Ryzen 3 or the Core i3s at the budget end of the spectrum, there's a processor for everyone.

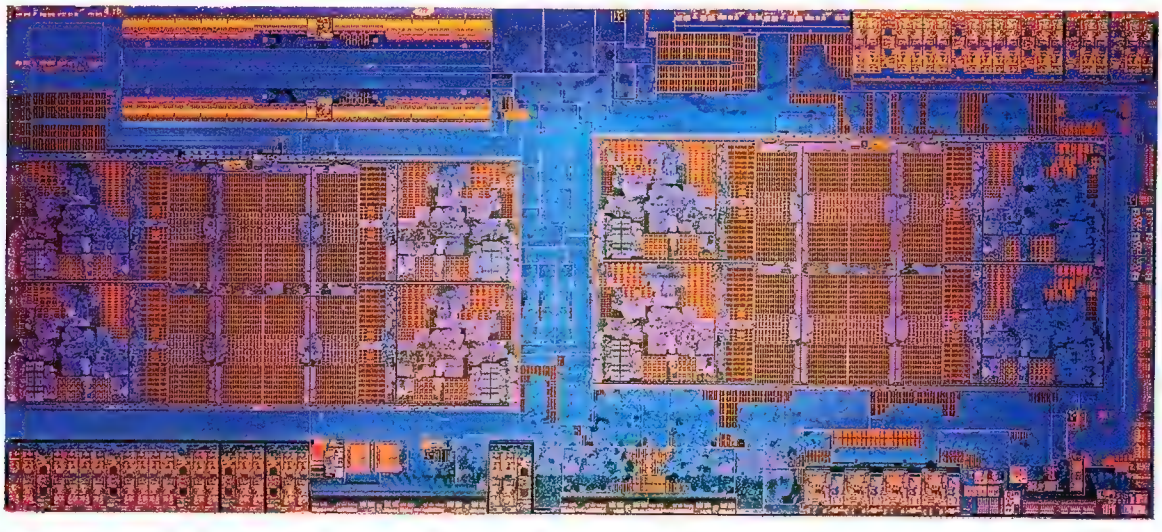
However, Ryzen certainly isn't perfect, and even Don Woligroski – AMD's Desktop CPU Marketing Manager – when speaking to YouTuber JokerProductions, stated that Ryzen was a "worst case scenario" for AMD. A new architecture on a new node brings up a whole plethora of issues, including memory and BIOS bugs, power draw woes, and overall lower frequencies than what were originally intended.

Ryzen 2, known as Pinnacle Ridge, looks to correct these issues. Rumoured to be released some time in the first quarter of 2018, we're expecting a drop to a 12nm production node (down from Ryzen's current 14nm), higher base clock frequencies, lower power draw, and two brand new X470 and B450 chipsets to accompany the retention of the AM4 socket (allowing for backward compatibility with previous chipsets). All of which should bring up single-core performance to Skylake and Kaby Lake levels, and in turn enhance multicore performance as well. On top of that, it should also help refine the platform further, with enhanced memory support, better overclocking, and improved motherboard design, and potentially also allow AMD to introduce more PCIe lanes to its newer chipsets.

It would also be highly surprising if we didn't see AMD launch its range of Vega-powered Raven Ridge APUs some time around Q1 as well. Hopefully, they'll bring more options to those interested in building a budget-friendly low-spec gaming machine or media PC. Rumour has it, these should feature four Zen cores (or two Ryzen core complexes, with support for 8MB of L3 cache, and multithreading), and 11 Vega GPU cores, and should prove to be quite the beast at 1080p low- to mid-range gaming.



Zen is only the start of what Ryzen has to offer.



The genius of Ryzen lies within its Infinity Fabric interconnect.

DECIPHERING INTEL'S NEXT GEN

What exactly does Intel's hunt for that elusive 10nm process node mean for us?

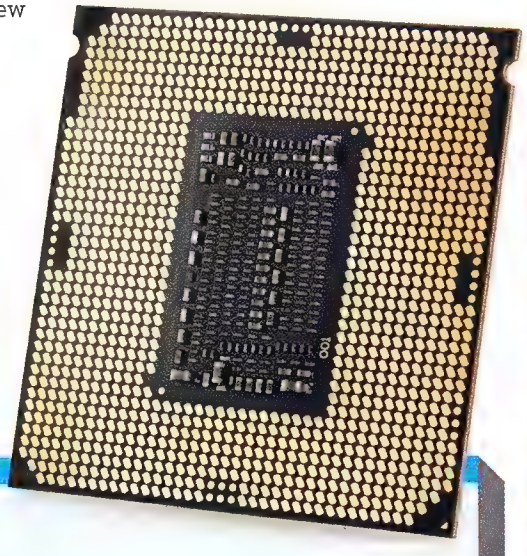
But what about our dear Team Blue? Well, Intel's hardly out for the count – it still holds on to a massive chunk of that processor market share, and with that in tow, pumping more money into R&D is an easy task for the chip-making giant. Combine that with its Core architecture still being far superior to AMD when it comes to single-core performance, and all is not lost. Coffee Lake proved to us that Intel was willing to listen, and at last we've finally witnessed more cores piled into its smaller form factor chips. With the 1151 socket now hosting up to six cores and 12 threads on its highest Core i7 flagship parts, the future certainly looks bright for those looking to stick with Intel.

So what's next? Well, Coffee Lake is Intel's fourth 14nm product, and the start of its eighth generation of processors. Although the company has confirmed that Coffee Lake is the last of its 14nm product line (not including the Kaby Lake R 14nm++ mobile refresh), confusingly, it's not the last of its eighth-gen chips. Cannon Lake will also fall under the same categorical nomenclature, even though it's a process shrink down to 10nm. Confused? You're not the only one. Typically, when Intel still ran its Tick Tock methodology, it would release an architecture, then shrink the process, with each step being a new 'generation' of processors. Although Tick Tock was recently retired for PAO (Process, Architecture, Optimization, each step still being a new 'generation'), Cannon Lake's 10nm process shrink still falls under the "Eighth" generation of processors, according to Intel.

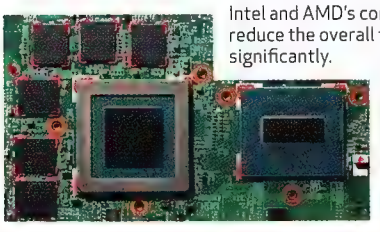
From this, we can predict two things. Firstly, that Cannon Lake's 10nm processors should be backward compatible with the Z370 chipset and socket; and secondly, that process shrinks will no longer be defined as a new generation, presumably indicating that a reduction in transistor size isn't providing Intel with the individual core performance boost that it was hoping for, with it more likely leading to reduced power draw instead.

That said, the drop to 10nm is intriguing, as it should reduce the overall size of the silicon die by 28.6%. Combined with a lower power draw, Intel should be able to incorporate more cores into its mainstream processors without increasing the size of its chip, or changing the LGA 1151 socket design too significantly. Intel has stated that it'll be producing a "lower volume SKU" of Cannon Lake early in 2018, before ramping up production within the first half of the year to full capacity.

Then, of course, there's the chipsets. Expect a new one (likely Z390) before the end of the first quarter, tapping into the full potential of these eighth-gen processors.



Coffee Lake makes six cores the norm for high-end Intel.



Intel and AMD's combined efforts reduce the overall footprint significantly.

In cahoots?

It would be remiss of us not to mention AMD and Intel's recent partnership in bringing one of the world's first Radeon and Intel powered SoC ultrabook combos together.

The aim is to reduce the overall form factor of gaming notebooks, from the usual 26mm thickness to something more classy and compatible with the Ultrabook form factor, without compromising on performance. To do this, Intel's taking advantage of its EMIB interconnect to incorporate HBM 2.0 memory stacks, a bespoke Radeon GPU core, and its own Intel processors, to reduce the footprint of its internal componentry significantly. We've yet to receive confirmation as to whether this will be a Vega- or Polaris-powered GPU, but it looks promising.

EMIB is a multi-die interposer technology, which allows Intel to incorporate multiple individual dies, at varying processing node sizes, across a single substrate, in very close proximity. So, for instance, you could see a processor using a 10nm process, with a graphics core at 14nm, and the dedicated I/O chip at 22nm, all within a single millimeter of each other, without issue. This leads to a cheap, small-form-factor interconnect that reduces power draw, temperature, height, and cost, with very little difficulty for the partners involved.

We expect to see ultrabooks powered by this new technology in the first quarter of 2018, potentially revolutionising performance in the ultra-slim form factor sector of the industry.

EVOLUTIONARY GREEN GPUS

Is Nvidia's Volta architecture the revolutionary GPU we've all been waiting for?

It would be fair to say that Nvidia has demonstrated a good show of force when it came to the grand GPU war of the last two years. Pascal has been out for well over 18 months now, and still continues to reign dominant over its red competitor. Radeon's Technology Group simply hasn't been able to compete, either at the mid range, with its Polaris-based RX 400 and 500 series cards, or even more recently at the very high end, with Vega falling flat on its face, far from the hype that surrounded it. But with little competition, what's the next step for the great green giant?

Well, that would be Volta. We've long been hearing rumours about Nvidia's latest and greatest architecture finally making it to the consumer market, and it's only now that we have any inkling as to what it might actually include. We know that TSMC is manufacturing the core, we know that it's operating off the 12nm FinFET production node, and we also know that there are already enterprise-grade accelerator cards in existence – powered, of course, by the magnificent might of the GV100 core. So, what can we expect from this new GPU lineup when it actually does launch consumer-side?

We can't say for certain, but looking back at the past may give us a clue. We know the number of CUDA cores found on both the current Pascal P100 GPU accelerator and the GTX 1080 Ti are the same. If that's the case, it's likely that Volta's V100 and the consumer-side 2080 Ti (whenever that launches; think 2019) will be identical. We can then calculate the percentage difference between the CUDA cores on the GTX 1080 Ti and the 1080, apply that to the V100's spec, and come up with a rough estimate of just how many additional CUDA cores Nvidia's next-gen flagship (the GTX 2080) might hold. The short answer is that it's a 33% increase in CUDA cores, and therefore pure GPU grunt over the last generation, and that's not including any architectural magic, or transition across to GDDR6 or HBM memory. A 33% minimum increase in brute force performance, which is exciting enough, if current price points hold across the generational jump.

Nvidia's co-founder and CEO Jen-Hsun hasn't stipulated that we should expect an immediate response to Vega, so it's unlikely we'll see these cards before the first quarter of 2018. However, with SK Hynix's recent announcement of its latest GDDR6 memory standard being produced for high-spec cards already, and Volta enterprise-grade GPUs now being available to the public, we'd be very surprised if we didn't see these launch before or at Computex 2018.

Can Nvidia's GV100 show us what its next-gen GPUs might look like?

HBM vs GDDR

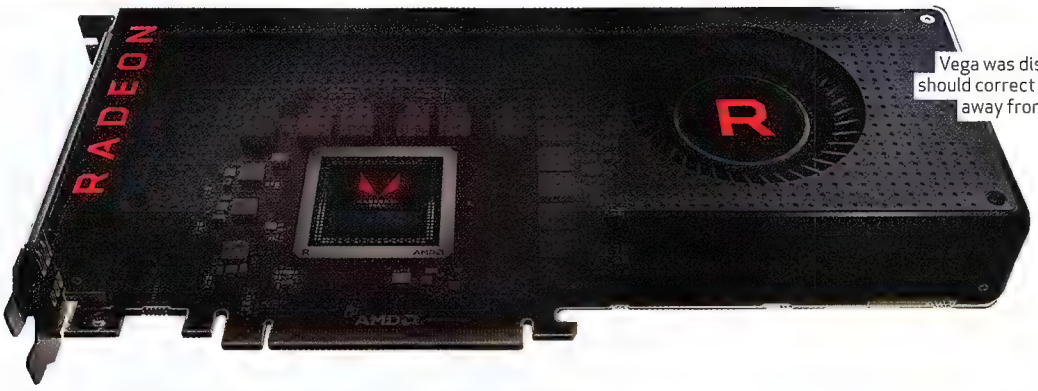
The battle for VRAM dominance needs settling this year. With both Nvidia and AMD utilising GDDR5X and HBM 2.0 in their product lineups, which is best, and what will we see on the GPUs of tomorrow?

Each has its advantages, but also its own disadvantages. HBM 2.0 takes up less PCB space than typical GDDR5X stacks, runs at 1.2V, has an incredibly low latency, puts out an astonishing amount of bandwidth (242GB/s per stack versus GDDR5/X's 44GB/s) and, more importantly, features Pseudo Channel mode, which splits a memory channel in two, with one pseudo channel dedicated to memory reads, and the other to writes. Think of it as multithreading, but for memory, and solely dedicated to read and writes, as opposed to processes.

That said, it has issues. It's expensive, in short supply (with only Samsung and SK Hynix currently producing it), and can be difficult to design new GPUs around, especially if the GPU in question is used across a range of cards, at different price points, such as the GP104, which covers the GTX 1070, 1070 Ti and 1080.

GDDR5X did address some of the discrepancies between the two standards, especially from a bandwidth perspective, and only then when competing alongside more consumer-friendly dual-stack Vega GPUs. However, latency is still an issue, and it lacks any form of multi-channel support. Which is why Nvidia currently incorporates HBM 2.0 into its high-end Tesla cards available today.

Fortunately, Micron has announced that it's mass-manufacturing GDDR6 modules, to be utilised by high-end GPUs early next year. GDDR6 garners a 4Gb/s bump



Vega was disappointing, but Navi should correct its mistake, and step away from the underwhelming GCN architecture.

AMD ON THE BACK FOOT?

Team Red needs Navi, and it needs it now.

It's been a rough year for AMD's Radeon Technologies Group. A really rough one. We didn't expect the slightly bashful underdog of GPU technology to produce anything astounding, but after delay, after delay, after delay, we did expect more than what we ended up with. Vega feels very much like a dud, especially as far as gaming is concerned. And although it powers through crypto-mining like a V8 through gasoline, when your flagship card can't compete with a competitor's 14-month-old solution in the things that really matter, you know you've got problems.

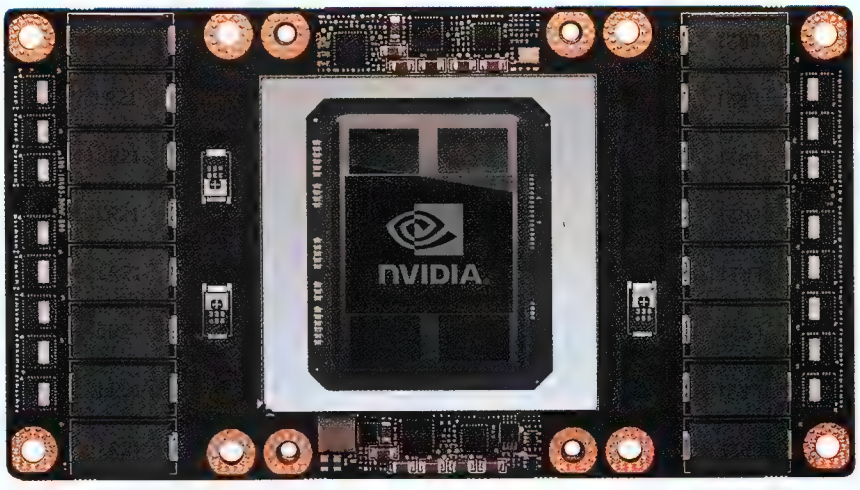
Combine that with the departure of Raja Koduri – AMD's Radeon Tech Group Leader – leaving for Intel, from the outside, at least, things look dire. But are they really? We doubt Raja would have left if things with AMD's next-gen architecture weren't already shored up. And much like Jim Keller leaving before Ryzen made it to market, there's the likelihood that Navi itself may also be finally on its way to completion, with the initial design stage out of the way. Sources suggest that AMD may indeed showcase one of its Navi GPUs at 2018's SIGGRAPH event around August this year, with a full commercial release coming at the end of 2018.

So what can we expect from the new architecture? Well, there are two exciting things to consider here. Firstly, there's the drop to 7nm. Secondly, there's AMD's recent development of its new interconnect, aka Infinity Fabric. What does that mean? In short, Vega currently operates off the 14nm manufacturing process; 7nm equates to a 50% increase in the overall number of transistors and, in turn, stream processors. On top of that, with AMD's Infinity Fabric, we may see the end of old-school monolithic GPU dies from the company. Instead of having one hard-to-manufacture, massive GPU die, as we've typically seen from GPU makers, AMD could do something similar to how it produces its Threadripper and Ryzen processors. In brief, smaller, less complicated GPU core complexes, with an interconnected fabric bridging performance between them, without increasing the complexity or cost of manufacturing the processors themselves.

It's worth noting that both AMD and Nvidia are looking to move away from the monolithic designs, as dropping down to the next process node becomes too taxing a task to achieve in the current climate.

Although we have no way of quantifying what kind of performance increase we could see here, the notion of adding more cores, at a fraction of the complexity and cost, may make Navi AMD's saving grace, and is certainly interesting when it comes to the future of GPU development.

But what about that 14nm+ refresh we keep hearing about? Well, our bet is we'll see a 14nm refresh of the RX 580, Vega 56, and 64, with a new low-power manufacturing process, being rebadged as new mid- to high-end GPUs, followed by one or two Navi 7nm cards in the same generation being the flagships with the new designs.



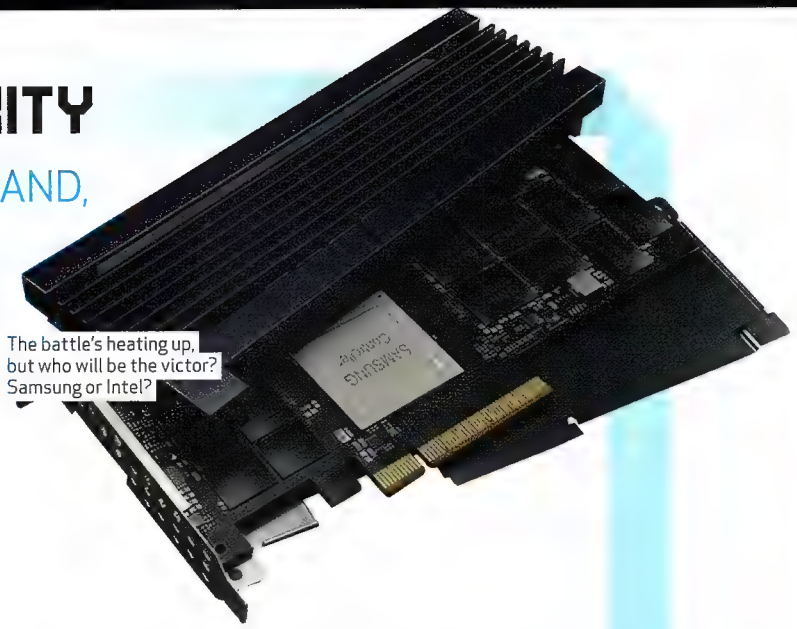
HBM isn't only seen on AMD-powered GPUs, but Nvidia ones, too.

in memory transfer speed and, more importantly, also features dual-channel support, which could help combat HBM's Pseudo Channel mode.

For the time being, it seems we'll still be stuck in this memory hierarchy, with GDDR5 and 5X featuring on more budget-friendly cards, GDDR6 on the high end, and HBM typically utilised on Vega and more workstation-oriented variants instead.

STORAGE SUPERIORITY

Intel vs Samsung, Optane vs Z-NAND, in a fight for the future.



The battle's heating up, but who will be the victor? Samsung or Intel?

The storage wars have been waging for quite some time now. Samsung's 960 series PCIe SSDs have comfortably sat top and centre of the non-volatile hill for the last 12 months. And with little challenge to the Korean giant, there's been no need for the company to reveal any new devices designed to push the boundaries of solid-state storage further. Even Intel and Micron have struggled to put up any resistance to the dominance of Samsung's 3D MLC V-NAND tech and its controller – at least, not until recently.

And then there are the connection standards, or perhaps it's more apt to just say M.2 at this point. Because that's the only connection standard still worth its salt in the PCIe board game. Intel's U.2, like many – if not all – closed-off proprietary connection standards, has fallen by the wayside, with lots of motherboard manufacturers no longer supporting it. With few devices operating on the standard, and the price-to-performance of Intel's 750 SSDs being less than desirable, there just wasn't enough choice to see it used enough.

This year hasn't been a complete dud for storage tech, though. Intel and Micron's design teams have finally brought the true might of their Optane 3D XPoint memory technology to market. First in the less-than-stellar Optane cache M.2 sticks, then in the phenomenal power of the 900P series SSDs. Although sequentials were lower than the competition, the stellar low latency and incredible 4K random reads and writes made it leaps and bounds more powerful than the prestigious 960 Pro.

Intel has promised that there's more to come from the fledgling resistive tech, but for the time being, the battle seems to be shifting away from how fast a sequential figure you can get, and more toward low latency and higher IOPs. Samsung is well aware of this, too, recently announcing the launch of its Z-NAND consumer SSDs.

Intel takes the advantage as the storage wars shift away from sequentials, and toward lower latency devices instead.

Z-NAND is, as far as we know, a derivation of Samsung's 3D NAND technology. Still built off the existing 40nm processing node, it's expected to feature a brand new controller, and a single-level cell design, as opposed to the 960 series multi-level cell. In short, the more data you store on a single bit of V-NAND both increases its latency and reduces the number of total read and write requests possible on the cell itself. SLC is far superior, but comes at a far greater cost and, unfortunately, lower density, meaning a larger PCB and, ultimately for Samsung, a PCIe add-in card, much like Intel's 900 series drives.

Although, for the time being, Z-NAND is enterprise only, we do have some figures for the drives, which can give us a bit of an idea about where the consumer equivalents will sit. Samsung revealed that both sequential read and write speeds will operate at 3.2GB/s, compared to Intel's 2.4GB/s read and 2GB/s write; random read IOPS will be up at 750K versus Intel's 550K; write IOPS will be 170K versus Intel's 500K; random read latency should be around 12–20 microseconds, compared to Optane's 10 microseconds; and, lastly, the random write latency will be 16 microseconds versus Intel's 10. Although not competitive across the board, if Samsung's drives arrive at a significantly lower price point than Intel's (because they rely on already well-established technology), they could render Optane redundant, unless you need it for very specific use case scenarios.

There's not been any confirmation of exactly when we expect to see a Samsung Z-NAND consumer drive appear, but we do expect these to drop some time during the first half of 2018.

TECHNOLOGY	Z-NAND	3D XPOINT
CAPACITY	800GB	750GB
SEQUENTIAL READ (GB/S)	3.2	2.4
SEQUENTIAL WRITE (GB/S)	3.2	2.0
RANDOM READ (IOPS)	750K	550K
RANDOM WRITE (IOPS)	170K	500K
RANDOM READ LATENCY (S)	12–20	10
RANDOM WRITE LATENCY (S)	16	10

THE FUTURE OF DISPLAY

Is 4K the new mainstream?

Bear in mind that ASUS, AOC and Acer's 4K 144Hz panels are made by the same manufacturer.

As far as screen tech is concerned, we've stagnated over the last 12 months. Although HDR was promised as the 'next big thing' from manufacturers across the globe, its impact on the computing industry has been stifled. With quantum dot, OLED and RGBW panels occupying the price point they do, and a lack of HDR content making it into the mainstream, the desire to invest in the new tech has been slim. Much like 4K before, it's taking time for the uptake of both content and screens to occur.

Speaking of 4K, not a lot has changed in this arena either. Panels have reduced in cost as more manufacturers bump up their production lines, and we're starting to see an abundance of screens pushing the 30-inch barrier, but apart from that, 2017 has been relatively quiet. We've not seen as much of an uptake into 1440p and higher resolutions as was expected, so development has tended to focus around higher refresh rate monitors instead.

Which segues nicely into a discussion of where we're going in the future. So what can we expect from 2018? Well, as far as flagships are concerned, we're expecting high-refresh 4K panels to finally arrive. Although DisplayPort has been capable of handling 4K at higher than 60Hz since way back in 2014, as far as GPUs are concerned, it's been nothing more than a far-fetched fantasy. AMD's RX series GPUs and Nvidia's GTX 10 series were the first to support DisplayPort 1.4, enabling enough bandwidth to go beyond 60Hz at 4K. Technically, DisplayPort 1.3 supported that, but not with HDR as well. In 2018, ASUS, Acer and AOC are all producing 120Hz-plus 4K screens with HDR by default. We expect these to launch early in the year, presumably after CES. However, it's likely that these will be priced out of the stratosphere, with most probably retailing close to the $3,000 bracket.

Although not realistic for the majority of us, this does give us hope that the next generation of 4K screens will come down in price. Combined with more powerful, more affordable GPUs, the dream of an affordable 4K gaming combo is inching ever closer.

VIRTUAL RENAISSANCE

Does the resurgence of virtual reality lie with the next generation of headsets?

Ahh, the jilted lover of the computing world. The buzz word that was on every journalist's lips. Was virtual reality just another gimmick? Or was it misrepresented? Ahead of its time? It's difficult to say for sure, as sales have been reasonable, with both Oculus and HTC profiting from the VR experience, but little has come out of 2017 with regard to the new way of consuming media.

There have been price drops, for sure, with both platforms being reduced by about $300–$400. And there's plenty of content, too, from an army of indie developers, and other games being made VR-compatible (there are 266 games and experiences currently listed in Steam's Virtual Reality category).

But the headsets still have problems. The 2,160 x 1,200 (1,080 x 1,200 per eye) resolution, so close to your eyes, still features that visible screen door or grid effect, and the refresh rate is still locked to a nauseating 90Hz. Ideally, we need to see a pixel density two to three times greater than what we have today before VR becomes more akin to gaming on even a 1080p screen. However, with Oculus announcing it won't be releasing a Rift 2 any time soon, and with HTC's latest Vive Focus concentrating on mobile, it's unlikely we'll see these changes make their way into the consumer ecosphere in the near future.

All that aside, early last year, Samsung's screen manufacturing division showcased a new display designed specifically for VR headsets. Cramming an incredible 2,024 x 2,200 resolution into a 3.5-inch form factor, it added over 86% more pixels into the same space. That's a pixel density of 858, versus the 460 of the original.

Perhaps 2018 will be the year when we finally see someone outside of the HTC and Oculus community bring a headset to market that actually makes sense for the graphically aware consumer. Or, better yet, see Microsoft's AR HoloLens project reach a more affordable level than the $4,369 price tag it's currently associated with. ■

Although exceptionally interesting, AR is just too pricey right now to justify.

STREAMING MEDIA PLAYERS
TELSTRA TV 2 vs FOXTEL NOW BOX + SIX MORE MOVIE & TV STREAMERS COMPARED
TECH life AUSTRALIA
PLUS!
BOOST YOUR BINGE
SECRET STREAMING TIPS & TRICKS FOR BETTER BINGING ON NETFLIX, STAN AND MORE
LOUNGE ROOM UPGRADE
UNCOVERED: THE BEST GEAR & GADGETS TO CREATE THE ULTIMATE AT-HOME TV & MOVIE VIEWING EXPERIENCE (WITHOUT SPENDING A FORTUNE)
• TECH SMARTS MADE EASY •
ISSUE 72 | JANUARY 2018 | TECHLIFER TECHLIFER APPLE NEWSSTAND & GOOGLE PLAY
DISCOVER NEAT TECH TRICKS
WINDOWS 10 FALL UPDATE: WHAT YOU NEED TO KNOW
MAKE YOURSELF A SOCIAL-MEDIA MASTER ON TWITTER
PRO GUIDE TO SETTING UP POWERLINE NETWORKING
HUGE BUYER'S GUIDE UPDATE!
NO BUM STEERS: WE'VE PICKED THE BEST TECH GEAR ACROSS 110 CATEGORIES, SO YOU'LL NEVER BUY A LEMON!
ESSENTIAL TECH, NEWS, REVIEWS & KNOW-HOW: GRAB YOUR COPY TODAY!
ON SALE NOW

Boot Time Test
Advanced...
BootRacer
BootRacer will measure your Windows boot time on the next reboot
Would you like to restart your computer now?

HOT HOLIDAY HOW-TOs

REVITALISE YOUR PC

Nick Peers reveals the tips and techniques you need to boost your PC's performance and lengthen its life.

Does your PC struggle to keep up with the demands you place upon it? Do you think that it might be time to bite the bullet and buy a new one? If your PC is under five years old, there's a good chance you can extend its life without having to incur the cost of a total replacement. In this guide, we'll show you all the tips and tricks you need to speed up your PC – and many of the techniques we reveal won't cost you a dime.

There's the inevitable clean-up, of course – most speed problems can be traced to the increasing load on your computer over time, so we'll start things off by stripping things back there. This is often compounded by the fact that Windows Updates can be less than optimal at cleaning up after themselves, so tossing out the junk, and getting rid of things you don't need can often have a significant effect on the overall speed of your machine.

After that, we'll help you examine the time it takes your system to start up – not only will our tips and tricks eliminate boot-time bottlenecks, but you'll also free up more system resources, and give your computer a new lease of life. Honestly, even if your machine feels fine to you right now, speeding up your Windows boot can have a serious effect on your perception of how responsive it is (or isn't). We'll then look into some clever system tweaks that can free up your machine even further, helping to improve its responsiveness and performance when heavier demands are placed upon it. And if there's a particular job you need to perform at the fastest possible performance, we'll show you how to strip everything else back.

Follow our guide to its end, and you'll wonder why you ever thought about replacing your PC, as it frees itself from its shackles, and really starts to fly.

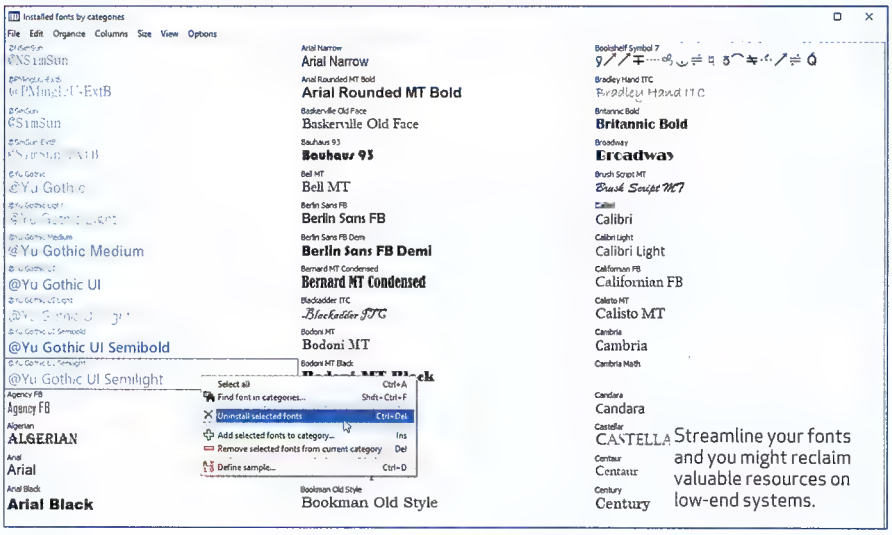
Perform a quick clean-up

Before you start targeting specific areas of your computer, begin with a much-needed clear-out of key areas of your system. Here's how...

Step one to speeding up your PC is giving it a clear-out. If your last spring clean wasn't long ago, you might be tempted to skip this, but you'll be surprised by how quickly detritus can accumulate, so these tips are still worth following.

First, we need to ensure there's sufficient free space on your system drive – aim to leave at least 5GB (preferably much more) spare. Open File Explorer, right-click your drive, and choose Properties. Click 'Disk Clean-up', wait for the scan, then click 'Clean up system files' to find more files to clear out. You may need to scroll through and check further items to clean up; select each one to read more about it, as some – such as ESD files – are best left in place.

If you want to push things further – or you're still lacking free space – follow the 'Clear Out Using CCleaner' boxout right. You can download and install CCleaner from **www.piriform.com**.



Streamline your fonts and you might reclaim valuable resources on low-end systems.

CLEAR OUT UNUSED APPS

It doesn't matter how diligent you are, at some point, you'll start to accumulate redundant programs on your PC, each one demanding its share of space and system resources. You can manage these from the Programs and Features Control Panel (Windows 7 or 8.1), 'Settings > Search and apps > App sizes' (Windows 8.1 – Store apps only), and 'Settings > Apps' (Windows 10 – desktop and Store apps).

That's all well and good, but programs leave bits of themselves behind – leftover files and Registry entries. If you don't plan to reinstall the app again, these can be safely deleted with the help of a third-party program, such as Revo Uninstaller Portable (**www.revouninstaller.com** – click Downloads, followed by 'Free Portable'). Note that Revo Uninstaller only works with desktop programs. You can clear out both desktop programs and Windows Store apps (including those pre-installed with Windows) using IObit Uninstaller 6 Free (**www.iobit.com/en/advanceduninstaller.php**) instead. Make sure that you skip the pop-up offer when you come to download it, and we also recommend installing Unchecky (**www.unchecky.com**) first – this will ensure that you don't inadvertently agree to installing the complete IObit Advanced SystemCare suite, as well as helping to keep other unwanted software off your system.

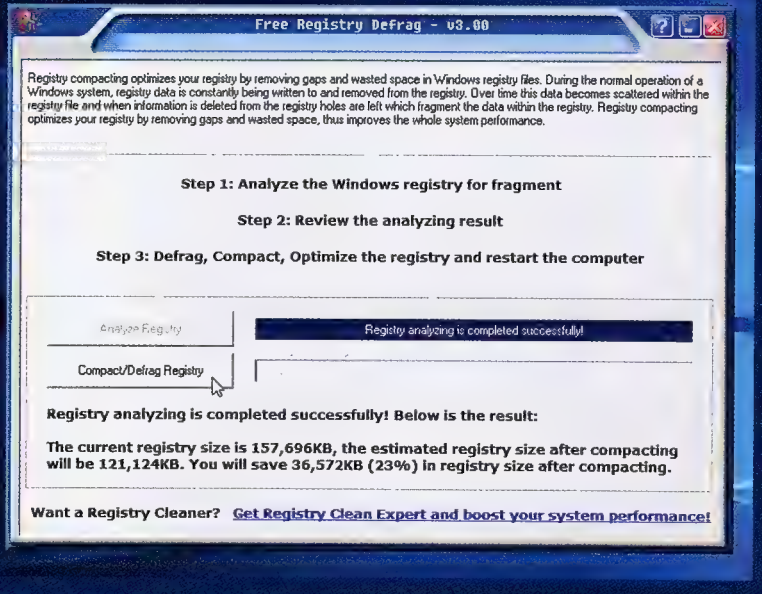
Both CCleaner and IOBit Uninstaller 6 Free work in the same way: Take a System Restore point if offered, then let

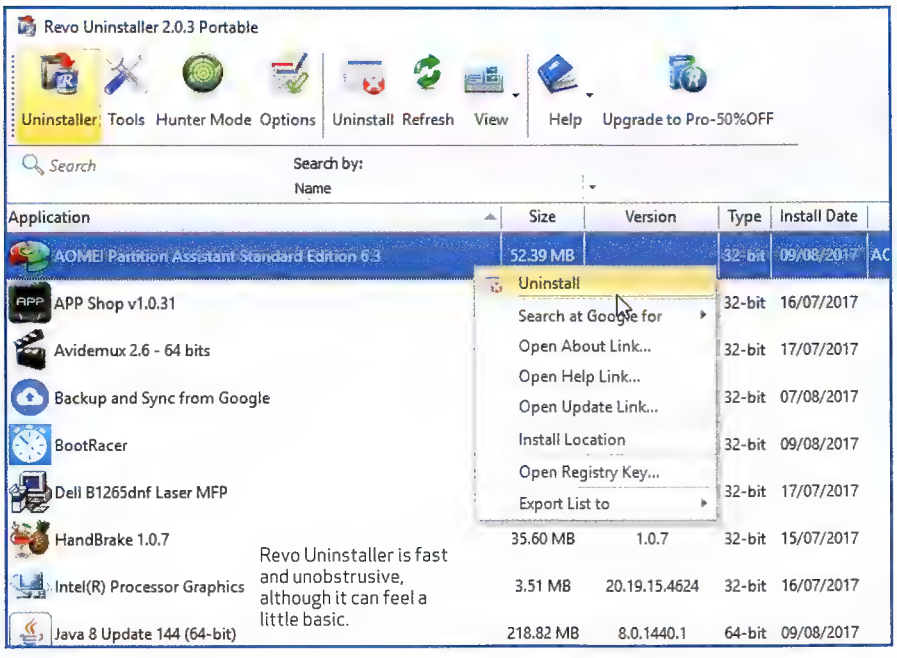
Registry cleaning

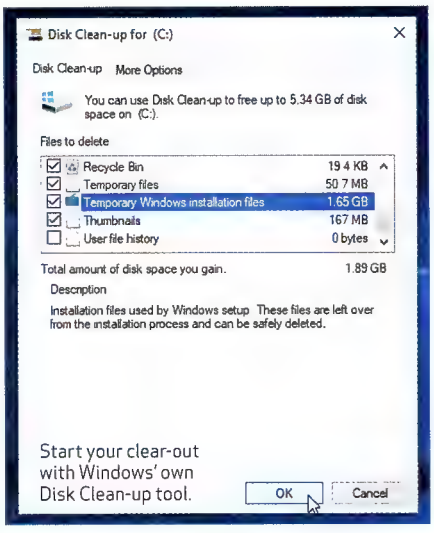
Third-party clean-up tools — such as CCleaner — include Registry cleaning tools, with the promise of streamlining and speeding up Windows. These tools scan areas of the Registry for supposedly redundant entries, offering to delete them. Hundreds or even thousands of entries get removed at a time, but even if your tool doesn't accidentally delete an important Registry entry (and it will, sooner or later), Registry cleaning offers no benefit to performance whatsoever.

You can potentially improve performance — but not by much — by defragging the Registry files (known as 'hives') using a dedicated tool, such as Registry Defrag Free (**www.registry-clean.net/free-registry-defrag.htm**). It analyses the Registry and tells you whether significant 'bloating' has taken place; if it has (over 10%), you can take a Restore Point, then let the program compress and defrag the files.

If you're running Windows on an SSD, there's little benefit in defragging the files. In most cases, you'll also find that Windows has done a reasonable job of keeping the hives in good order, making the process redundant.


Free Registry Defrag - v3.00
Registry compacting optimizes your registry by removing gaps and wasted space in Windows registry files. During the normal operation of a Windows system, registry data is constantly being written to and removed from the registry. Over time this data becomes scattered within the registry file and when information is deleted from the registry holes are left which fragment the data within the registry. Registry compacting optimizes your registry by removing gaps and wasted space, thus improves the whole system performance.
Step 1: Analyze the Windows registry for fragment
Step 2: Review the analyzing result
Step 3: Defrag, Compact, Optimize the registry and restart the computer
Analyze Registry
Registry analyzing is completed successfully!
Compact/Defrag Registry
Registry analyzing is completed successfully! Below is the result:
The current registry size is 157,696KB, the estimated registry size after compacting will be 121,124KB. You will save 36,572KB (23%) in registry size after compacting.
Want a Registry Cleaner? Get Registry Clean Expert and boost your system performance!




Disk Clean-up for (C:)
Disk Clean-up
More Options
You can use Disk Clean-up to free up to 5.34 GB of disk space on (C:).
Files to delete
Recycle Bin
19.4 KB
Temporary files
50.7 MB
Temporary Windows installation files
1.65 GB
Thumbnails
167 MB
User file history
0 bytes
Total amount of disk space you gain.
1.89 GB
Description
Installation files used by Windows setup These files are left over from the installation process and can be safely deleted.
Start your clear-out with Windows' own Disk Clean-up tool.
OK
Cancel

the program's own uninstaller get on and do its job. Don't reboot if prompted; instead, run the scan to view and delete both leftover files and Registry entries. For more details, see the 'Registry Cleaning' boxout on the opposite page.

While you're going through your installed apps — particularly if you're running a low-powered machine — consider ditching any resource-hungry programs for their lightweight equivalents. Microsoft Office, for instance, too much for your tablet or low-end laptop? Remove it and then install WPS Office 2016 (**www.kingsoftstore.com**) or LibreOffice (**www.libreoffice.org**) instead. Also, try switching to portable apps, where possible, to prevent clutter from accumulating on your PC's main storage drive — save these to a separate partition or drive instead, and they'll also survive Windows reinstallation, with all your settings intact, too.

FINISH YOUR CLEAN-UP

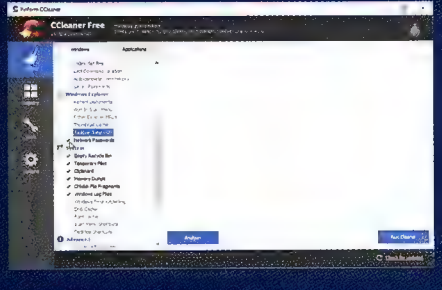
Most of our lives are spent on the internet, so if your web browser is starting to creak at the seams, consider taking steps to give it a clean-up and refresh. First, perform an audit of all the browser add-ons you've installed — the procedure for reviewing what's installed varies from browser to browser: Chrome users should type "chrome://extensions/" into the Address Bar, for example, while Firefox users can use "about:addons".

Disable or remove any add-ons or extensions that you no longer need — if you have a lot of items and multiple browsers to process, you'll find that both CCleaner ('Tools > Browser Plugins') and IObit Uninstaller ('Toolbars & Plugins') make it easy to manage everything from one convenient spot.

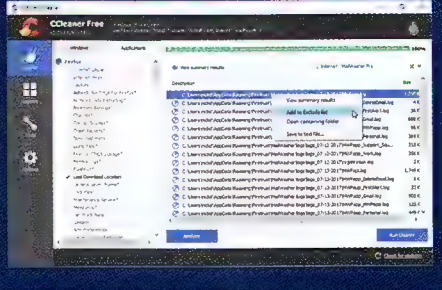
Another area to focus on is fonts. If you have a lot of fonts installed on a low-memory PC, they affect performance. Manage them using AMP Font Viewer (**www.ampsoft.net/utilities/FontViewer.php**), which makes it possible to uninstall those you don't use regularly, loading individual or groups of fonts back into memory for temporary use when the need arises.

There's one major area we've yet to look at, and that's the start-up process. Turn the page for a complete guide to both monitoring the boot process and optimising it to speed up how quickly your PC starts up. We'll also explain how to optimise system resources further.

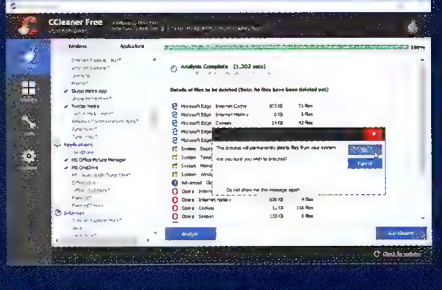
Clear out with CCleaner



1 START CLEANING
Launch CCleaner. Go through the Windows and Applications tabs in the Cleaner section, reviewing each item, unchecking those you wish to keep. Pay particular attention to the Windows Explorer section. Once satisfied with what you've selected, click the Analyze button, and wait for the scan.



2 REVIEW CAREFULLY
When complete, a summarised list is displayed. Be sure to right-click any questionable items and choose 'View detailed results'. You can protect individual files from being deleted by right-clicking them and choosing 'Add to Exclude list' or uncheck the list and click Analyze to perform a fresh scan.



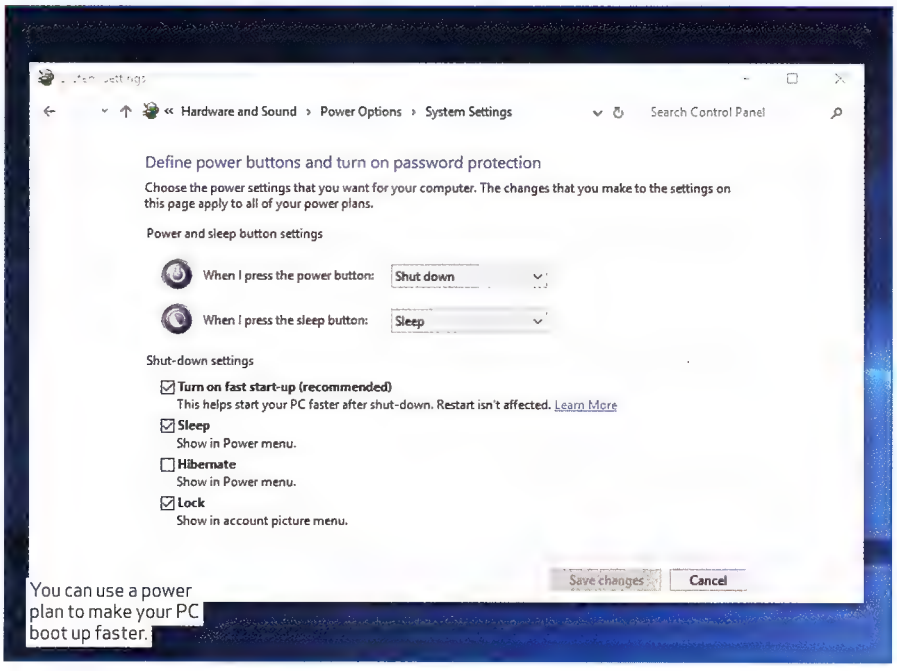
3 RINSE, THEN REPEAT
When you've finished reviewing everything, click 'Run Cleaner'. Read the warning — this is your last chance to turn back — and click Yes to delete the files. Going forward, you can run further scans, or quickly right-click individual categories in the list, and choose Analyze or Run Cleaner for a targeted clean-up.

Revitalise your PC

Slash your boot times and free up vital system resources at the same time to give your PC a handy speed boost — this section shows you how.

Over time, you'll notice how much longer it takes Windows to start up. Optimising your startup times isn't simply about getting your PC to boot faster, though – it also has a beneficial effect on your machine's general performance. That's because, as you install programs on your computer, some of them configure themselves to load at startup. The process of loading these startup apps naturally lengthens boot times, but the apps also consume additional resources, producing a drag on your computer's overall performance, too.

Some startup processes – such as your security software – are essential and shouldn't be touched. Others, such as your cloud sync app, are best left running, too, but you'll find many apps and programs aren't used often enough to justify allowing them to gobble up resources in the way that they do. The trick is identifying and disabling them.

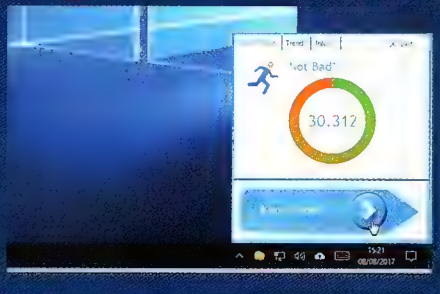

« Hardware and Sound › Power Options › System Settings
Search Control Panel
Define power buttons and turn on password protection
Choose the power settings that you want for your computer. The changes that you make to the settings on this page apply to all of your power plans.
Power and sleep button settings
When I press the power button: Shut down
When I press the sleep button: Sleep
Shut-down settings
Turn on fast start-up (recommended)
This helps start your PC faster after shut-down. Restart isn't affected. Learn More
Sleep
Show in Power menu.
Hibernate
Show in Power menu.
Lock
Show in account picture menu.
Save changes
Cancel
You can use a power plan to make your PC boot up faster.

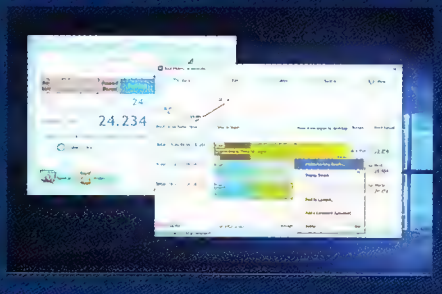
MONITOR BOOT TIMES

Startup programs aren't the only things that slow down Windows' boot time. The step-by-step guide below shows you how to monitor your boot time and manage startup programs using the free BootRacer app. You'll see that it divides the boot process into four stages. The first is pre-boot, and this covers the time it takes your computer to initialise its hardware and run various checks before handing over control to Windows. The figure should be three to five seconds on a PC with Fast Boot enabled – see the 'How Fast Boot works' boxout above-right for more details.

If it doesn't appear to be enabled, type "power" into the Search box and click 'Choose a power plan'. Click 'Choose what the power buttons do'. If 'Turn on fast startup (recommended)' isn't checked, click 'Change settings that are currently unavailable', check the box, and click 'Save changes'. Should you need to

Measure and improve boot times





1 FIRST STEPS
Download bootracer_freeb.zip from **www.greatis.com/bootracer** and extract the MSI file inside. Double-click this to install the program. Click Finish when complete. The main window opens automatically — click 'Boot Time Test', then Yes to restart your PC and perform the first boot test.

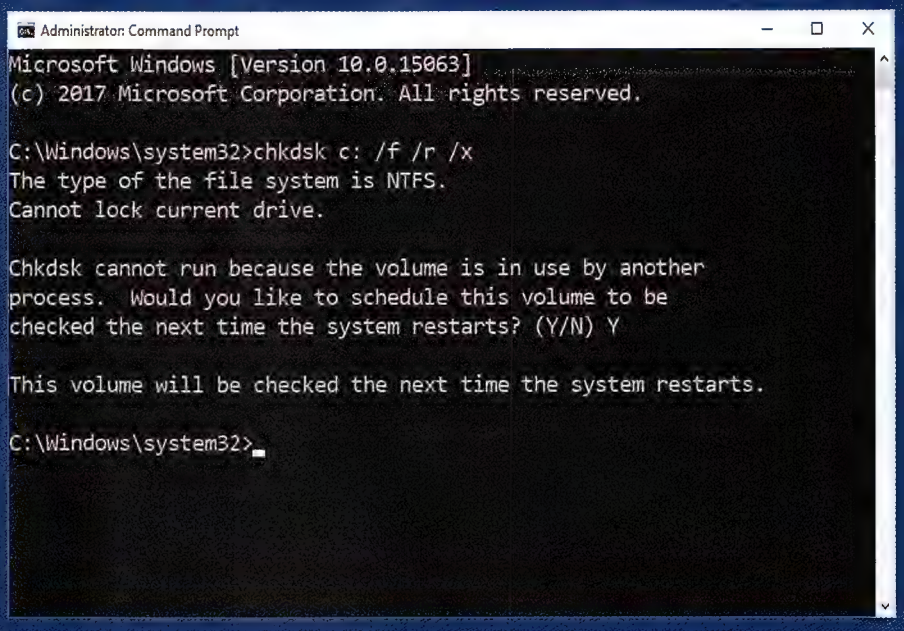
2 TEST AND REVIEW
Windows restarts as normal with one difference. When the desktop appears, you'll see a countdown timer appear in the bottom-right corner. When complete, a stopwatch showing your boot time is displayed. When the summary screen appears, click 'Know more' to review the result in detail.

3 DETAILED ANALYSIS
BootRacer splits the results into four parts — see the main text above for a detailed explanation of each. BootRacer performs the same test each time you restart Windows, so restart again to repeat the test at least once to get more results to compare. Click History to see the trend over time.

How Fast Boot works

When you switch on a Windows 7 machine, it always starts from a 'cold boot', which has to load Windows from scratch. With the advent of modern PC hardware and the launch of Windows 8.1 (and now Windows 10), supported PCs can be instructed to switch on Fast Boot instead.

This uses 'hybrid shutdown', a feature that effectively hibernates your PC, rather than shutting it down completely, by storing the contents of memory in a special file, called hiberfil.sys. When starting back up, the file is loaded back into memory — a much quicker process than starting Windows completely from scratch.


Administrator: Command Prompt
Microsoft Windows [Version 10.0.15063]
(c) 2017 Microsoft Corporation. All rights reserved.
C:\Windows\system32>chkdsk c: /f /r /x
The type of the file system is NTFS.
Cannot lock current drive.
Chkdsk cannot run because the volume is in use by another process. Would you like to schedule this volume to be checked the next time the system restarts? (Y/N) Y
This volume will be checked the next time the system restarts.
C:\Windows\system32>

"You need to reboot to run Disk Check. Be patient — it may take some time to complete, and appear to be stuck."

access the UEFI settings going forward, go to 'Settings > Update and recovery'. Click 'Restart now' under 'Advanced startup', then select 'Troubleshoot > Advanced Options > UEFI Firmware Settings'.

SPEED UP WINDOWS BOOT

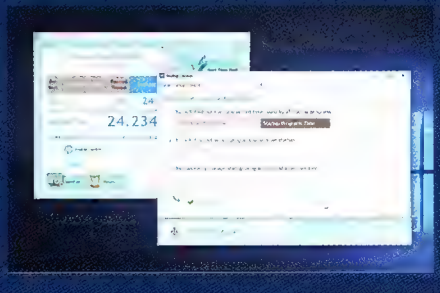
The Windows Boot section refers to the time your PC takes to get to the login screen. This is determined by your version of Windows as well as the speed of your drive – under 10 seconds on a fast SSD, for example – and the drive's condition.

If the time has got noticeably longer (minutes rather than seconds), check the condition of the drive. To do that, open a Command Prompt window with admin privileges – Windows 8.1 and 10 users can choose 'Command Prompt (admin)' after pressing Win-X – then type the following, and hit Enter:

```
chkdsk c: /f /r /x
```

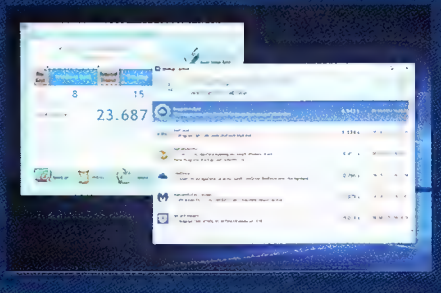
You need to reboot to run Disk Check. Be patient – it may take some time to complete, and appear to be stuck at certain points. If errors are found and fixed, you should find that Windows now boots more quickly.

If you're running Windows 7 on a non-SSD drive, click 'Start > All Programs > Accessories > System Tools > Disk Defragmenter' to analyse and – if necessary – defragment the drive. Again, if defragmentation is required, you should find performance improves.



4 TAKE CONTROL

BootRacer can be used to monitor (and control) individual startup programs and processes. Click 'Startup Control', then click the button next to Disabled to enable it. Click Next, leave the Enabled box checked to measure program start times, and click 'Restart your PC and Analyze Results'.



5 MONITOR APPS

Now, when Windows reboots, startup apps are paused until the desktop has finished loading, then each one is timed. Keep an eye out for programs that take much longer than others to complete loading — click 'Which programs slow down startup?' to analyse the results in greater detail.

6 MANAGE STARTUP

Click 'Startup Control' and you can disable (clear the check) or even delete startup items like other apps, such as CCleaner. Click 'Set Order' and you can even change the order in which startup programs are run, ensuring important apps launch before others. Click 'Finish Reordering' when you're done.

Tune up Windows

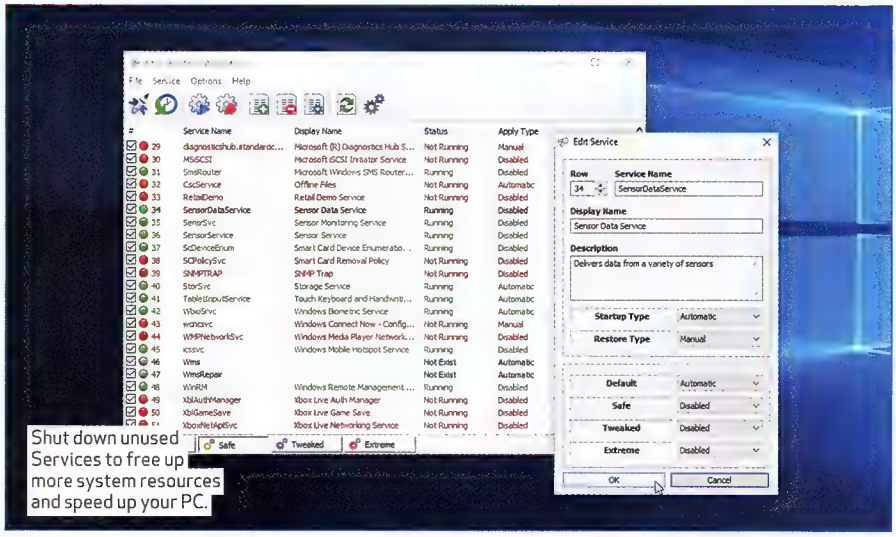
Discover more tips, tricks, and tweaks that you can use in Windows to deliver even more speed improvements to your machine.

You've cleaned up your PC, but there's still lots of room for improvement. If it's still struggling on a day-to-day basis – particularly if it has 2GB of RAM or less – it's worth exploring additional ways to free up more resources by optimizing which services (low-level processes) are running in the background.

Doing this by hand is tricky and time-consuming, which is where Easy Services Optimizer (**www.sordum.org/?p=8637**) comes in. This makes it easy to disable a range of services safely to recover the resources you need. Once downloaded, you can quickly tweak your system one of four ways: Default (your existing setup); Safe (a good choice for most); Tweaked; and Extreme. The higher up you go, the more likely it is you'll lose functionality, such as support for printers or Bluetooth devices. If an option doesn't work, roll back to Default.

If you'd rather temporarily suspend resources while running a specific app – a game, say – try JetBoost (**www.bluesprig.com/jetboost.html**) instead. Once installed, launch the program, and click the big blue button to shut down services. Run your app, then after closing it, click Restore to put things back the way they were.

Advanced users can click 'Customize' to add custom processes, services (typically non-Windows services, but avoid key ones such as security software) and 'other', which includes ensuring your power settings are set to high performance.



Shut down unused Services to free up more system resources and speed up your PC.

TUNE UP SEARCH

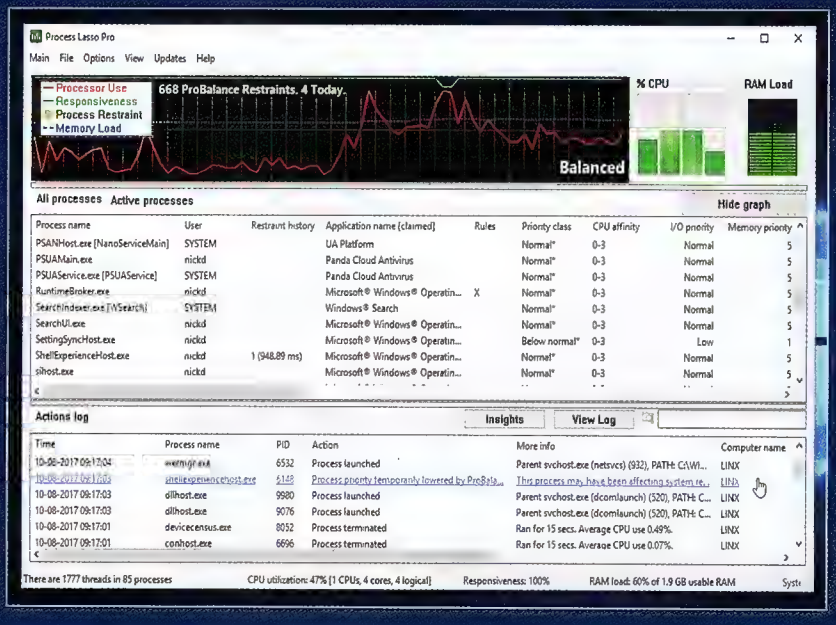
If you're not averse to keeping documents and other files outside your key user folders, chances are Windows takes a long time to find them when you perform a search – if they're found at all. Let Windows add these locations to its index, and future searches will be much quicker. Open File Explorer in Windows 8.1 or Windows 10, and click inside the Search box to open the context-sensitive Search tab on the Ribbon. Click 'Advanced options' and choose 'Change indexed locations'. Windows 7 users should type "indexing" into the Start menu's search box, and click 'Indexing Options'.

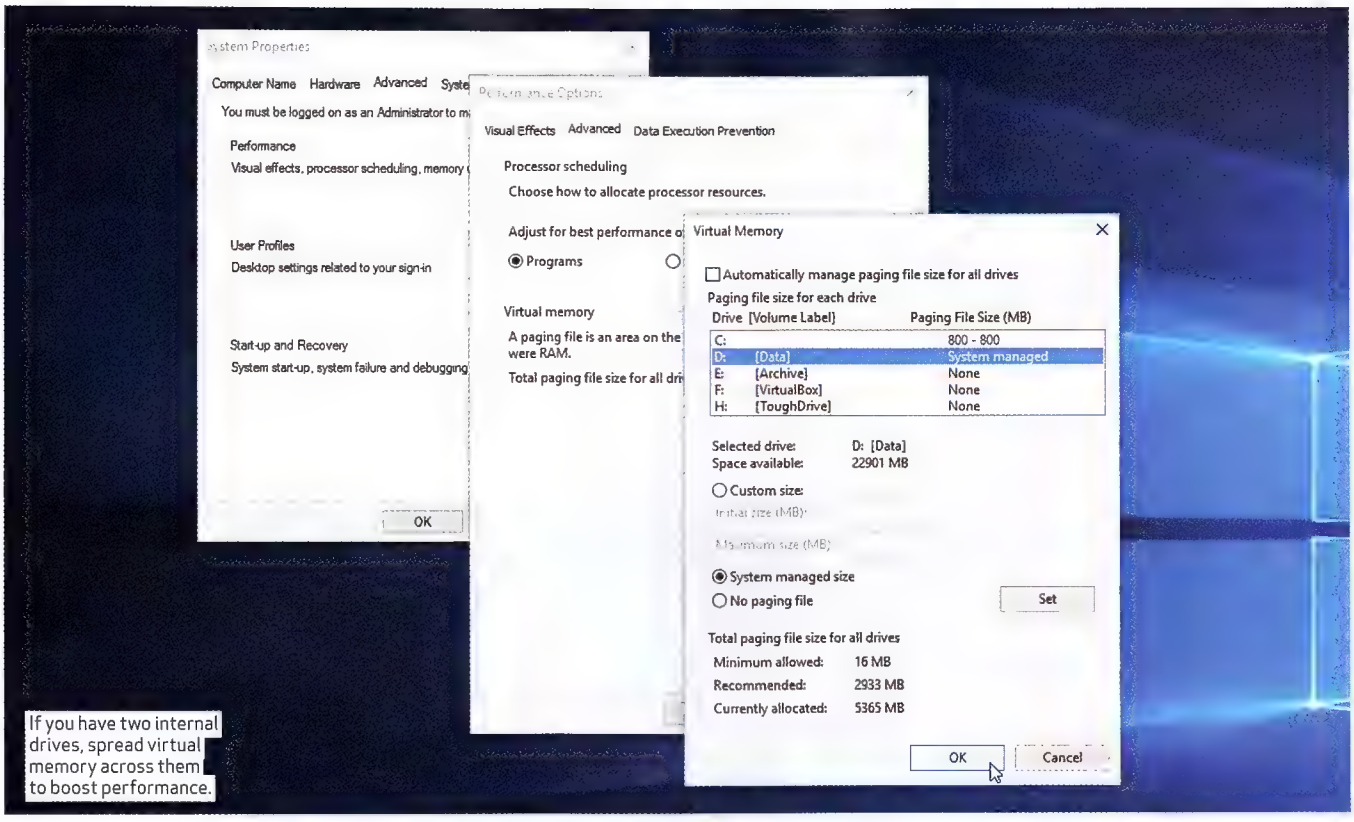
From here, click Modify to add the folders containing your files to the index – also consider removing those locations you don't need indexed, to keep things streamlined. Once done, Windows takes some time to index the new locations fully – this is much quicker on SSDs, obviously.

Tame rogue programs

If your PC occasionally — or even frequently — finds itself grinding to a halt before mysteriously coming back to life again, it's likely that a rogue process or program is attempting to claim more system resources than are available. It's a problem that affects older and slower machines, and the solution lies in a program called Process Lasso (**bitsum.com**). This app runs in the background and offers several performance benefits, the key one of which is ProBalance. This keeps an eye out for those processes attempting to grind your system to a halt. When Process Lasso spots one, it immediately reduces that process' priority level, to prevent it from stealing too many system resources, so keeps your PC running smoothly as a result.

Be sure to download either the 32-bit or 64-bit version, according to your system type — older and low-memory PCs tend to be running 32-bit Windows, but confirm this by pressing 'Win-Pause/Break'. The free version of Process Lasso is all you need, and because everything is done automatically, you can leave this handy tool to its own devices once installed.





If you have two internal drives, spread virtual memory across them to boost performance.

If you've partitioned your drive, move your search index off your Windows system drive, and you'll be able to easily restore it after reinstalling Windows in the future. To do this, click Advanced, followed by 'Select New' under 'Index location' to choose another drive or partition to put it.

OPTIMISE MEMORY SETTINGS

The following tweaks aren't necessary if your PC is packed with RAM or you're running an SSD, but they help PCs with 2GB or less running 32-bit Windows on a regular hard drive. You need a USB 2.0 or better flash drive with 4GB of free space, enabling you to use the spare capacity on larger drives for other purposes. Windows should be able to automatically detect when you've plugged it in, and offer to use all or some of it for ReadyBoost. If not, open File Explorer, right-click the USB drive, and choose 'Properties > ReadyBoost tab'.

The second tweak requires that your PC has two internal hard drives — both non-SSD. It enables you to move your paging file — which Windows uses for virtual memory — to the second drive, which can also give overall performance a boost.

Press 'Win-Pause/Break', click 'Advanced system settings', switch to the Performance tab, and click Settings. Switch to the Advanced tab, and click Change.

Uncheck 'Automatically manage paging file size for all drives', then select your current Windows drive (usually drive C). Choose Custom and enter "800" into both the 'Initial' and 'Maximum Size' boxes, before clicking Set. This 800MB file is required to enable Windows to boot. Now select your second drive (or — if it's been partitioned — the least-used partition on that drive), and choose 'System managed size'. Click Set again, then click OK three times, and reboot.

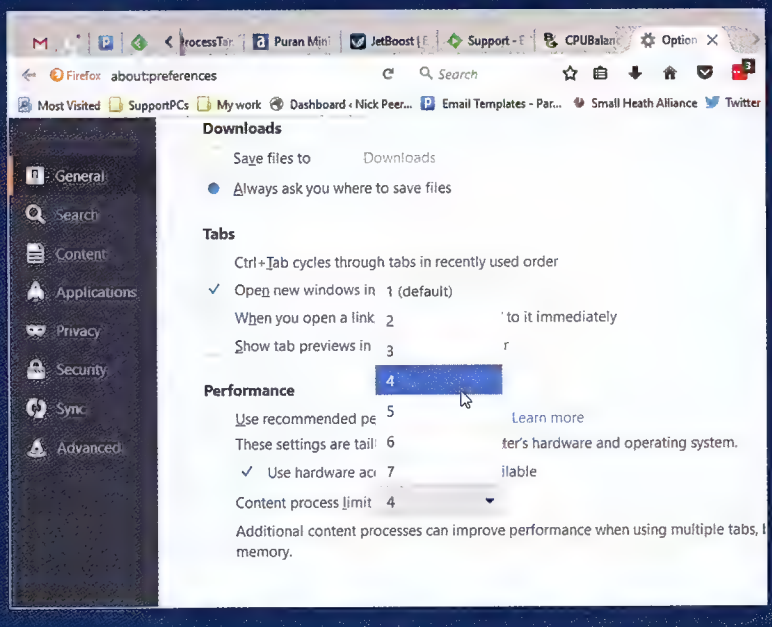
Once done, return to this screen to verify the correct settings are in place (800MB for drive C; and 'System managed' for your second drive). This should lead to improvements in your PC's performance.

Speed up your browser

If your web browser is groaning under the weight of all those open tabs, you might be able to improve performance without having to close them all. If you're a Firefox user with lots of RAM, open 'Settings > General', and uncheck 'Use recommended performance settings'. Then, if it's not grayed out, up the 'Content process limit' to four or even higher, to see whether it helps.

Next, there are a few browser-related efficiency tips you can try to speed things up generally. First, enable your browser's Bookmarks bar, giving you one-click access to your favorite websites. Also, right-click frequently used tabs, and look for a 'Pin Tab' option, to make them permanently available.

Speed up logging into websites — and make them more secure at the same time — using either the LastPass (**www.lastpass.com**) or KeePass (**www.keepass.info**) password managers. Finally, make better use of search engine timesavers — Google users can perform quick conversions direct from the search bar ("$5 to CAD"), and search a specific website's content by prefixing the search terms with "site:techradar.com" for example.


Firefox about:preferences
Search
Most Visited SupportPCs My work Dashboard ‹ Nick Peer... Email Templates - Par... Small Heath Alliance Twitter
General
Search
Content
Applications
Privacy
Security
Sync
Advanced
Downloads
Save files to Downloads
Always ask you where to save files
Tabs
Ctrl+Tab cycles through tabs in recently used order
Open new windows in 1 (default)
When you open a link 2 to it immediately
Show tab previews in 3
4
Performance
Use recommended pe 5 Learn more
These settings are tail 6 ter's hardware and operating system.
Use hardware ac 7 ilable
Content process limit 4
Additional content processes can improve performance when using multiple tabs, l
memory.

Create a user-friendly rescue USB

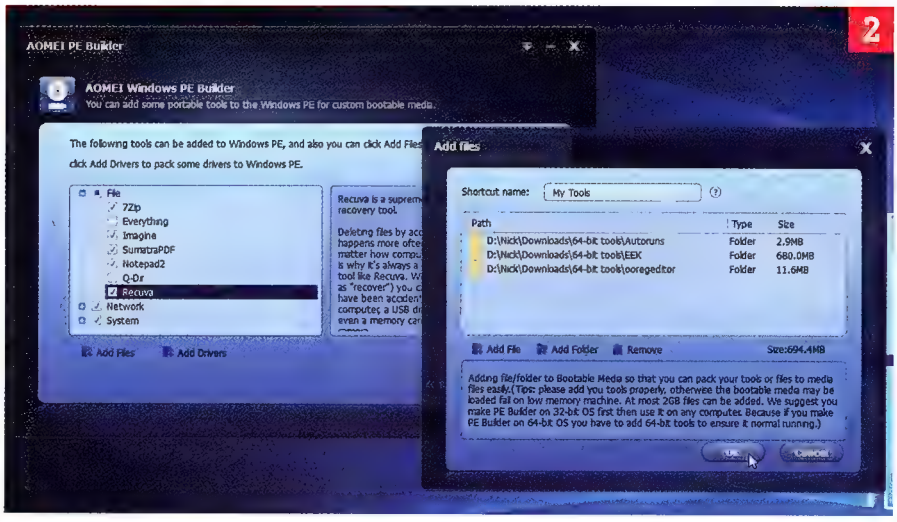
HOT HOLIDAY HOW-TOs

When all seems lost... who ya gonna call? Nick Peers!

If Windows fails to boot, or you're otherwise locked out of your system, what can you do? Built-in recovery tools are certainly helpful, but they're not the most user-friendly. Microsoft developed a special 'pre-installation environment', called Windows PE, which gives you access to a cut-down version of Windows that can be started from a bootable DVD or USB flash drive. It's basic, but it contains a familiar, user-friendly graphical interface that gives you access to your system even when it won't boot.

Creating this recovery media by hand can be tricky, but AOMEI PE Builder 2.0 doesn't just simplify this process, it makes it possible for you to build your own customised recovery disc, complete with the tools you know and trust for recovering data, restoring a previous backup, researching the problem online, and even performing certain repairs to bring your ailing PC back to life.

In this tutorial, we're going to show you how to build (and use) your own customised rescue media using PE Builder, which now runs on all flavors of Windows, from Windows XP up to the latest iteration of Windows 10. Without further ado – and while your PC is still working correctly – let's jump on the recovery wagon.


2
AOMEI PE Builder
AOMEI Windows PE Builder
You can add some portable tools to the Windows PE for custom bootable media.
The following tools can be added to Windows PE, and also you can click Add Files/click Add Drivers to pack some drivers to Windows PE.
File
7Zip
Everything
Imagine
SumatraPDF
Notepad2
Q-Dir
Recuva
Network
System
Add Files
Add Drivers
Add files
Shortcut name:
My Tools
Path
Type
Size
D:\Nick\Downloads\64-bit tools\Autoruns
Folder
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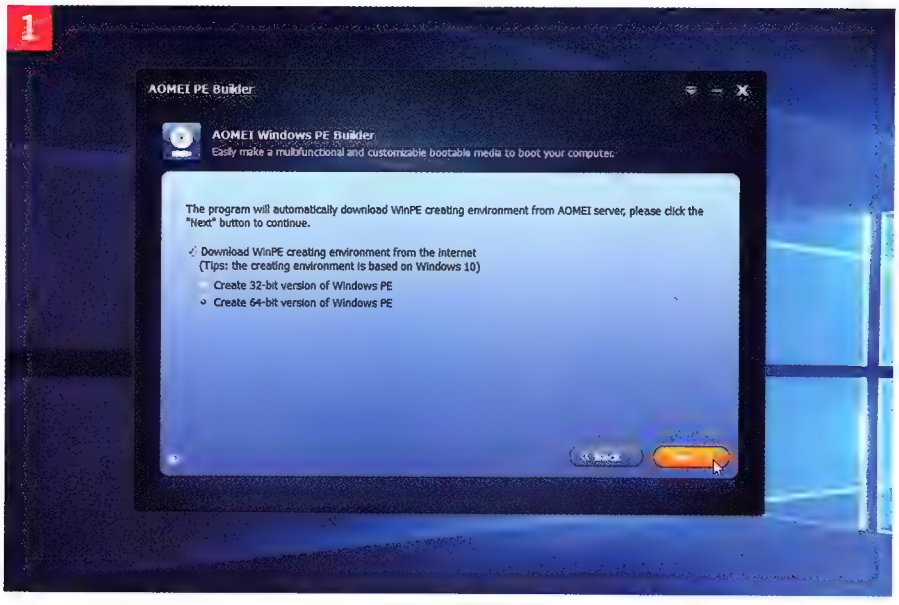
D:\Nick\Downloads\64-bit tools\EEK
Folder
680.0MB
D:\Nick\Downloads\64-bit tools\pooregeditor
Folder
11.6MB
Add File
Add Folder
Remove
Size:694.4MB
Adding file/folder to Bootable Media so that you can pack your tools or files to media files easily.(Tips: please add you tools properly, otherwise the bootable media may be loaded fail on low memory machine. At most 2GB files can be added. We suggest you make PE Builder on 32-bit OS first then use it on any computer. Because if you make PE Builder on 64-bit OS you have to add 64-bit tools to ensure it normal running.)

1 DOWNLOAD AND INSTALL

Head over to **www.aomeitech.com/pe-builder.html**, where you'll see a pair of links, for 146MB and 72MB downloads. The larger download contains AOMEI's Partition Assistant and Backupper utilities, which will be incorporated into your rescue disc. These are key tools – Partition Assistant can recover lost and deleted partitions, for example, while Backupper can be used to take a full system image of your drive – so we recommend downloading the 146MB version.


1
AOMEI PE Builder
AOMEI Windows PE Builder
Easily make a multifunctional and customizable bootable media to boot your computer.
The program will automatically download WinPE creating environment from AOMEI server, please click the "Next" button to continue.
Download WinPE creating environment from the internet
(Tips: the creating environment is based on Windows 10)
Create 32-bit version of Windows PE
Create 64-bit version of Windows PE

- Once downloaded, simply double-click PEBuilder.exe, and follow the on-screen prompts to install the software. Once complete, launch it from the Start menu or via a search for "AOMEI".

2 SELECT RESCUE DISC SYSTEM TYPE

The opening screen provides a series of hyperlinks, explaining various aspects of the rescue disc's interface, as well as included tools and utilities. Once you've reviewed these, click Next. By default, 'Download WinPE creating environment from the Internet' is selected – it's required if you're running Windows XP, Vista, or 10, and is recommended (but not compulsory) on Windows 7, 8, and 8.1, too [**Image 1**].

- Your key choice here is 32-bit or 64-bit. Typically, you should choose the same system type as your own Windows installation (press 'Win-Pause/Break' if you don't know this), but there are two considerations. First, 64-bit boot media will work with both older BIOS and newer UEFI systems, while 32-bit media only supports older legacy systems (see the troubleshooting box over the page for a possible workaround). Second, you need to source portable apps and drivers of the same system type as your rescue disc – 32-bit apps are more common than 64-bit ones. Make your choice, then click Next.

3 CUSTOMIZE PORTABLE APPS

Expand the File, Network and System sections to see what bonus tools are included with your rescue disc by default. Select one to read a description. In most cases, you'll leave these all selected – but we recommend deselecting the web browser QtWeb (it doesn't work properly in 64-bit environments).

- Click 'Add Files' to add your own portable tools to the rescue disc – up to 2GB of programs can be added this way. It's worth gathering these apps in their own folder, then adding each tool's subfolder individually as shown [**Image 2**] – they'll be accessible from the rescue disc's desktop under the UserTools folder. See the box opposite for tips on tools to look for, but remember you can also run portable apps directly off other drives, so long as they're detected by your rescue media, so don't go overboard.

4 ADD CUSTOM DRIVERS

All the core drivers you need – graphics, keyboard, mouse and wired network – should be covered by PE Builder, but there's a chance that certain network (specifically Wi-Fi) and hard drive (storage controller or RAID) drivers aren't present, while some advanced USB mice and keyboards aren't recognised either. You'll only discover this after you've created (and booted from) your rescue media, though.

- If you discover missing drivers, you need to source the driver installation files yourself to add them to your recovery media from this screen. First, obtain the latest version of driver from the manufacturer – if you're struggling to track it down, try **www.driverscape.com**, where you can search a range of popular PC and laptop models, as well as hardware devices.
- You need to be able to extract the contents of whatever driver file you download, so you can locate a .INF file, which is what PE Builder needs to build the driver from. Use a tool such as 7-Zip (**www.7-zip.org**) to do this – if the file is a setup.exe file, try 'Open inside' to see if the driver files can be manually retrieved; if not, you need to look elsewhere for the drivers.
- If you're able to obtain the files and all-important .inf file, return to PE Builder, and click 'Add Drivers' followed by 'Add File' to locate and select the .inf file you identified [**Image 3**]. Click 'OK' followed by Next when you're done.
- If you're attempting to add drivers to your boot media, we suggest taking out an insurance policy by clicking 'Add Files' again – this time, click 'Add Folder' and add the folder containing your extra drivers to your rescue media. This will enable you to attempt a manual installation of those drivers within the recovery environment, should they not automatically load with your rescue media. Once done, click Next.

5 CHOOSE BOOT MEDIA

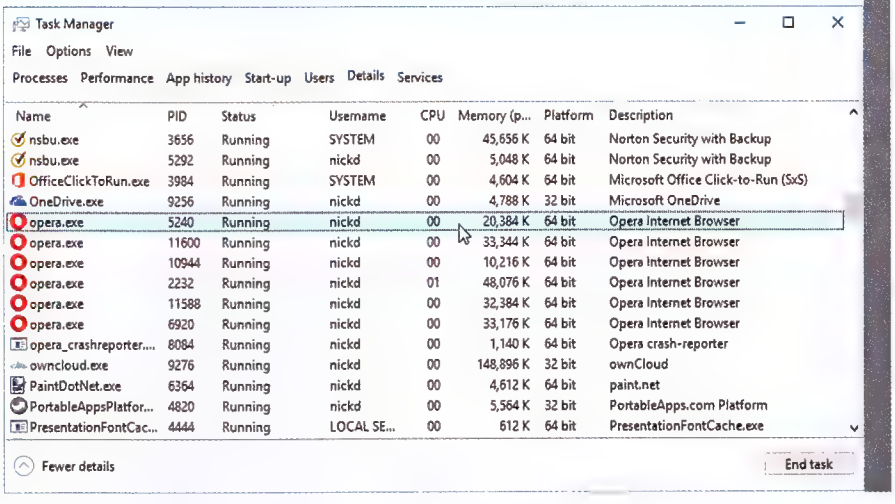
Your rescue disc is now ready to be burned or copied. Select 'Burn to CD/DVD' if you have a blank DVD inserted (we recommend rewritable media, because you may find your disc doesn't work, or requires tweaking later). Alternatively, select 'USB Boot Device' to choose a flash drive to build the recovery media on – note the drive is completely wiped by this process, so copy off any data you wish to keep from it first. If more than one USB

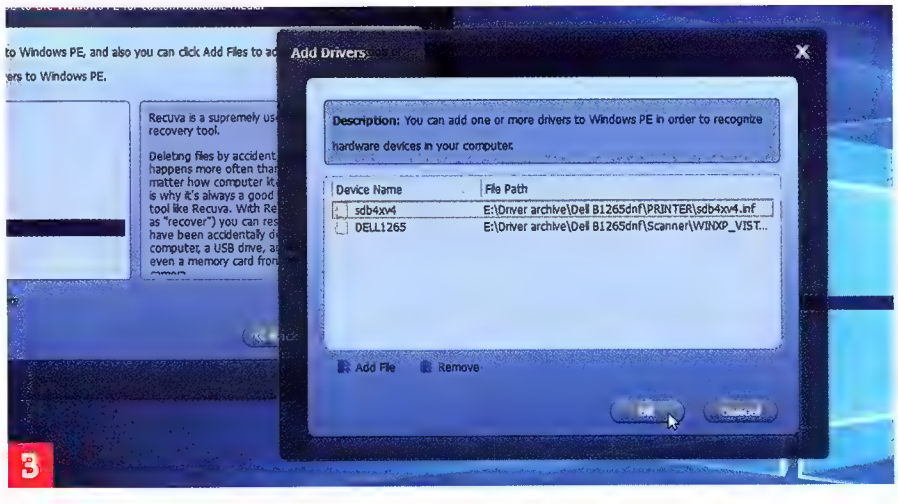
Build a portable digital toolkit

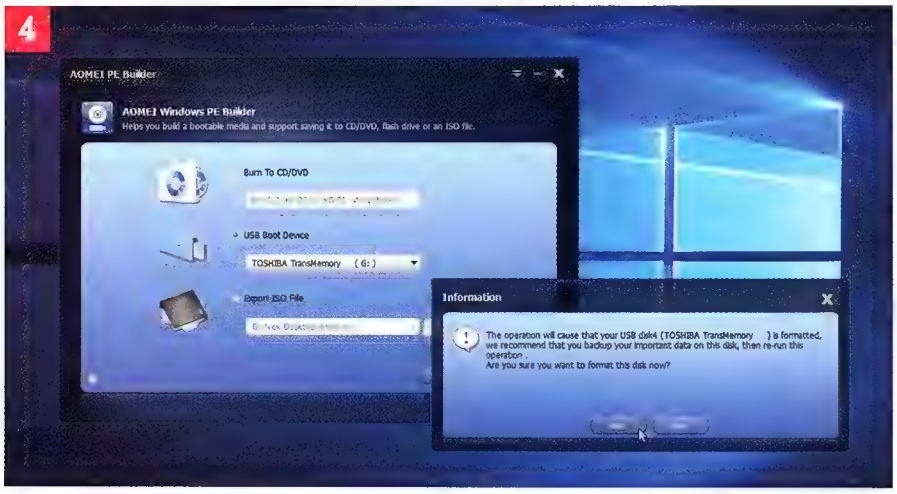
You can incorporate additional portable tools in your AOMEI rescue disc, giving you access to a wide range of additional apps and utilities. Just one golden rule: Your portable app must match the system type (32-bit or 64-bit) of your rescue disc. To determine this, first launch the app, then open Task Manager. Switch to the Details tab, right-click the column headers, and choose 'Select columns'. Select Platform and click OK. Locate your program, and you'll see it's listed as either 32-bit or 64-bit.

Start your search for portable tools at **portableapps.com**, where you'll find most bases are covered, particularly for 32-bit apps. Tools to grab from here include Autoruns (manage startup items), SSD-Z (check hard drive health), Teracopy (faster file transfers), FileZilla (FTP transfers) and PuTTY (SSH into other machines). Visit the programs' home pages to source 64-bit versions.

We also recommend Opera (**www.opera.com/computer/portable**) to replace QtWeb, data-recovery powerhouse DMDE (**www.dmde.com** — 32-bit only for free version), dual-engine anti-malware tool Emsisoft Emergency Kit (**www.emsisoft.com** — run it from a separate drive) and O&O RegEditor (**www.oo-software.com**) for editing your crashed PC's Registry.


Task Manager
File Options View
Processes Performance App history Start-up Users Details Services
Name PID Status Username CPU Memory (p... Platform Description
nsbu.exe 3656 Running SYSTEM 00 45,656 K 64 bit Norton Security with Backup
nsbu.exe 5292 Running nickd 00 5,048 K 64 bit Norton Security with Backup
OfficeClickToRun.exe 3984 Running SYSTEM 00 4,604 K 64 bit Microsoft Office Click-to-Run (SxS)
OneDrive.exe 9256 Running nickd 00 4,788 K 32 bit Microsoft OneDrive
opera.exe 5240 Running nickd 00 20,384 K 64 bit Opera Internet Browser
opera.exe 11600 Running nickd 00 33,344 K 64 bit Opera Internet Browser
opera.exe 10944 Running nickd 00 10,216 K 64 bit Opera Internet Browser
opera.exe 2232 Running nickd 01 48,076 K 64 bit Opera Internet Browser
opera.exe 11588 Running nickd 00 32,384 K 64 bit Opera Internet Browser
opera.exe 6920 Running nickd 00 33,176 K 64 bit Opera Internet Browser
opera_crashreporter.... 8084 Running nickd 00 1,140 K 64 bit Opera crash-reporter
owncloud.exe 9276 Running nickd 00 148,896 K 32 bit ownCloud
PaintDotNet.exe 6364 Running nickd 00 4,612 K 64 bit paint.net
PortableAppsPlatfor... 4820 Running nickd 00 5,564 K 32 bit PortableApps.com Platform
PresentationFontCac... 4444 Running LOCAL SE... 00 612 K 64 bit PresentationFontCache.exe
Fewer details
End task




4
AOMEI PE Builder
AOMEI Windows PE Builder
Helps you build a bootable media and support saving it to CD/DVD, flash drive or an ISO file.
Burn To CD/DVD
USB Boot Device
TOSHIBA TransMemory (G:)
Export ISO File
Information
The operation will cause that your USB disk4 (TOSHIBA TransMemory) is formatted, we recommend that you backup your important data on this disk, then re-run this operation.
Are you sure you want to format this disk now?

drive is connected to your PC, verify you have the correct one selected by its drive letter. The 'Export ISO file' option generates an ISO file you can burn or copy manually, or use in a virtual machine, such as VirtualBox. Click Next when you've made your choice. Read any warning [**Image 4**], then click OK.

6 CREATE DISK

Wait while your recovery media is created – the first time you run the tool, PE Builder downloads a Windows 10 PE installation image, but the file is retained for future use, so subsequent builds should be quicker, unless you switch system type between 32-bit and 64-bit. Once the process is complete, click Finish.

7 TEST MEDIA

Leave your bootable media inserted and reboot your PC to make sure it works. It may automatically be set to boot from your CD/DVD or USB drive, or you may need to look for an option to press a key – typically a function key – to select your boot device. Once selected, look for your CD/DVD or flash drive. If more than one option is supplied, try the UEFI option first; if that fails, try the USB option [**Image 5**]. If no option appears, or the disc or drive fails to boot, check out the troubleshooting box (left).

- If successful, be patient – the loading process is much slower than via hard drive, particularly if you've added lots of tools and drivers to your rescue media. Eventually, you should find yourself at the rescue media's desktop, with shortcuts to all the built-in tools. You'll find the resolution is set to 1,024 x 768, which makes it appeared squashed on widescreen displays. Sadly, this can't be changed, but it should give you enough room to troubleshoot in.

8 TEST NETWORK CONNECTION

Check to see if you have Internet access through your rescue media. The caveat is that Windows PE only works by default with Ethernet interfaces. Double-click the PENetwork icon to open PE Network Manager. If your Ethernet adapter has been detected, it should be listed. Click the Info button to see if it's been allocated an IP address. If it appears to have one, open your portable web browser to verify your internet connection works.

- If not, click Renew if you connect through DHCP, or 'Obtain an IP address automatically' to manually set a static IP address, subnet mask (255.255.255.0), and default gateway (the IP address of your router). Set the DNS server to your router's IP address; if that fails, try 208.67.222.222.

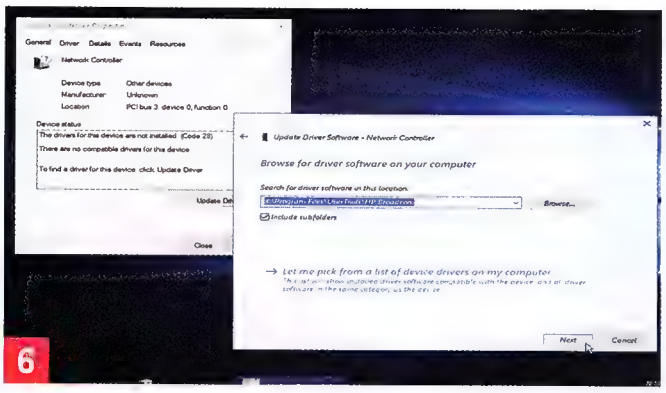
9 CONNECT THROUGH WI-FI

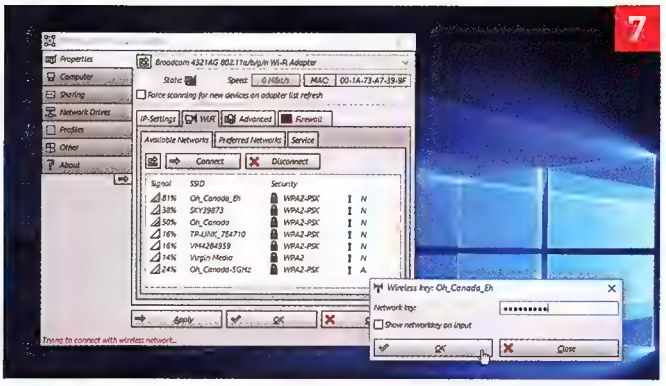
If you're trying to connect via Wi-Fi, click the drop-down menu to see if your adapter has been detected; in the likely event it hasn't, and you've manually added the driver folder to your rescue media (see step four), you can attempt to install it manually. Press 'Win-R', type "devmgmt.msc" and hit Enter. Look for a reference to Wi-Fi or Network Controller under 'Other devices'. Double-click this, then click 'Update Driver'. Choose 'Browse my

ASRock UEFI Setup Utility
Main
OC Tweaker
Advanced
Tool
H/W Monitor
Boot
Security
Exit
Boot\CSM(Compatibility Support Module)
Launch PXE OpROM policy
Launch Storage OpROM policy
Launch Video OpROM policy
Legacy only
Legacy only
Legacy only
Description
Enable to Launch the Compatibility Support Module. If you are using Windows 8 64-bit UEFI, and all of your devices support UEFI, you may also disable CSM for faster boot speed.
If your rescue disc or drive doesn't work as you expect it to during testing, check out these quick-fire fixes.

Troubleshoot your rescue disc or drive

- **32-bit rescue media isn't recognised:** 32-bit media requires an older BIOS-based PC or a newer UEFI PC with Compatibility Mode enabled and Fast Boot disabled. Choose the USB option in the boot menu.
- **Insufficient memory error:** PE loads everything it has into memory — if you've not got enough RAM, rebuild your rescue media with fewer tools.
- **Computer doesn't boot from USB:** Try burning a CD or DVD instead if your PC isn't capable of booting from USB devices (only the very oldest PCs shouldn't able to do this).
- **Certain hardware doesn't work:** There's no guarantee you'll get your hardware to work, even if you track down drivers. We failed to get two Wi-Fi adapters working (one code 37 error, another driver unrecognised), and our third only worked when we manually installed the driver after booting.
- **Program won't run in recovery environment:** Make sure it's the same system type (32 or 64-bit) as your rescue media; also try running from a separate drive.
- **I have another problem:** See the FAQ at **www.aomeitech.com/pebuilder/help/faq.html**.


Update Driver Software - Network Controller
Browse for driver software on your computer
Let me pick from a list of device drivers on my computer
Next
Cancel
6



computer for driver software'. Select the folder containing your drivers [**Image 6**], and see whether Windows is able to install them.

- If successful, go to PE Network Manager. Select 'Force scanning for new devices on adapter list refresh', switch to the Wi-Fi tab, click Start, then OK. Reopen the tool, and your Wi-Fi adapter should appear under the device drop-down. Select it, then switch to the Wi-Fi tab to connect to your local network [**Image 7**].

10 A BRIEF TOUR

Double-click the 'This PC' shortcut in the top-left corner to access File Explorer. You should see all drives (internal and external) appear. If any are missing, you need to source appropriate drivers (typically 'RAID' or 'storage controller' – consult your PC or motherboard's support site for them) to add to your rescue media. You'll notice a drive marked 'X' – this is the drive Windows PE has installed itself to, and is a 'virtual drive', in that it's stored in RAM. This is partly why it's restricted to 2GB, to work on lower memory (and 32-bit) machines. Your other drives should be recognisable by their drive letters – though some may have swapped around, so browse each one for confirmation.

- In case you ever find yourself using your rescue media to try to recover from a non-booting PC, now would be the time to work out which drive is your backup drive, then launch AOMEI Backupper from its desktop shortcut to take a full backup of your afflicted Windows system drive [**Image 8**]. This would enable you to then attempt repairs knowing your files are protected, should you be forced to perform a complete wipe and reinstall.

11 TEST YOUR APPS

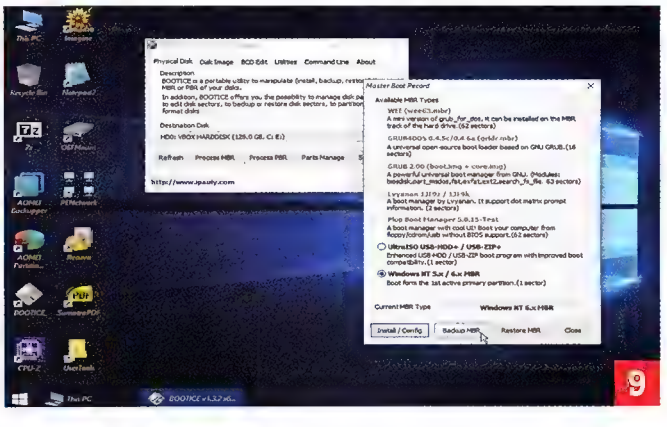
Open the UserTools folder via its shortcut to test any apps you've added. Not all will work, even if they are the correct system type. Non-functioning apps usually exhibit no symptoms – double-click the shortcut, but nothing happens, even after a wait (right-click the Taskbar and choose 'Task Manager' to see if anything is present).

- Some apps fail because they prefer to run from a physical drive – if you have a portable apps folder on another drive, try running them from there. There's no rule – other than convenience – that forces you to incorporate your apps into your rescue media.

12 QUICK-FIRE TIPS

There are no quick-and-easy repair tools built into the AOMEI rescue media – you may want to pair it with a Lazesoft Recovery Suite Home Edition recovery disc (**www.lazesoft.com**) to cover all bases. The PE environment is best used for backing up and recovering data, browsing the web to troubleshoot boot-related problems, and perform manual repairs. Built-in tools that can help include AOMEI Partition Assistant (recover lost or deleted partitions), BootICE (examine and repair boot entries), and Recuva (recover deleted files). You also have access to a limited set of system tools – press 'Win-R' to launch Control Panel (control.exe – most links don't work, however), Device Manager (devmgmt.msc)or Computer Management (comptmgmt.msc), among others [**Image 9**].

- One major thing to remember is that you're not directly plugged into your Windows installation. That means taking additional steps to connect to files and settings associated with your ailing Windows install.
- For example, to view and edit your BCD file on an older PC, with a BIOS rather than UEFI, you need to direct BootICE to the system reserved partition's Boot folder, and the Bcd file within. To manage your PC's startup entries in Autoruns, choose 'File › Analyze Offline System' and point 'System Root' to C:\Windows, and 'User Profile' to C:\Users\<Username>. Finally, editing your Windows Registry using O&O RegEditor would require you to point the program at C:\Windows. Replace 'C:' with whatever drive your Windows installation is on.
- Any changes you make to any apps incorporated in your rescue media are lost when you reboot, so while you might want to synchronise your Opera profile with the portable app to access your favorites and add-ons, for example, you'd need to do so every time you booted from the rescue media. To get around this, use portable apps stored on another drive, where changes are recorded. ■



RESURRECT YOUR FAVOURITE GAMING CLASSICS

HOT HOLIDAY HOW-TOs

Want to run old games on new Windows? Let Phil Iwaniuk show you how.

You place a treasured CD-ROM into the disc tray, wistful about the good old days, and excited to see the familiar pixels of an old favourite game. Your PC reacts like a dog watching a magic trick. Autorun doesn't work. Setup.exe doesn't work. InstallShield is looking for a long-forgotten Windows 98 library file in perpetuity. In a very real and upsetting way, your childhood is no longer compatible with the modern world, and you know that the only way to rekindle it involves hours of compatibility box-checking, Googling and fiddling. A traumatic moment.

But it doesn't have to be. Getting software that was designed for much older operating systems and hardware to run on modern machines offers its own intrinsic satisfaction. It's like breaking the rules, somehow, raising dead software that was never intended to interface with silicon this powerful, and bending an operating system to your will. There are many different avenues to pursue when you're attempting to do so, and that in itself has its own pros and cons. That variety of approaches means it's unlikely you'll truly reach a dead end, to stretch that avenue metaphor to breaking point. But it does also mean the plethora of conflicting information found on message boards suggesting this method or that can make this a tricky task to go about in a methodical manner.

So let's do exactly that! Let's turn what would ordinarily be an evening of directionless trial and error into a

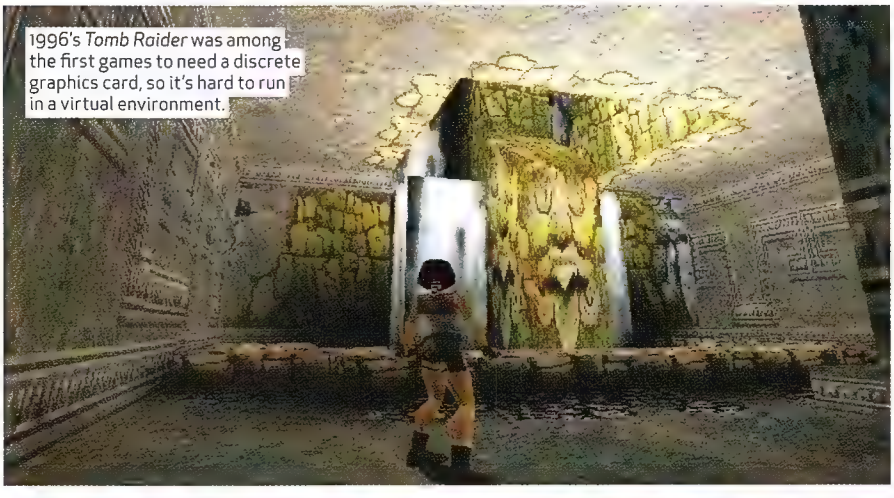
scientific process. The definitive and exhaustive guide to running old games on a new PC.

Lab coats are optional, but a willingness to install a few programs on your PC and a sound awareness of abandonware law are mandatory in this test environment. With those humble tools, you should be able to run any old game on a Windows 10 PC, however categorical the error messages seem upon the first attempt.

Before getting stuck into the many-branched methodology of old game necromancy, let's examine why this problem exists. After all, if a PC can run *The Witcher 3* at a dreamy 60fps, why does it struggle to render 1999 tactical shooter *Rainbow Six: Rogue Spear* at anything above single figures? And why is it so hard to get certain games even installed?

Essentially, it all comes down to operating systems. Whenever a piece of software or PC game is developed, its creators make a series of assumptions about the environment it'll be used in. The developers of 1999, for example, might reasonably have expected that most users would be installing their game on to a Windows 98 or Windows 95 PC, both based around the 16-bit DOS operating system. That, in turn, means an assumption about the file libraries and drivers contained within those operating systems, and the kind of hardware that might be running it. Those developers couldn't anticipate that later versions of Windows, from Win 2000 onward, would only emulate DOS, rather than running it natively, and that the code that installs and runs the game on DOS-based operating systems would eventually become gibberish to Windows 10. And they couldn't have known – how could anyone? – what a monumental pain in the posterior UAC would prove in later, more security-conscious Windows iterations.

Generally, then, programs don't work on modern machines because those modern machines are running a recent OS. Hardware tends to play only an indirect role in incompatibility. For example, because 32-bit systems recognize only a 4GB maximum of memory, most of us run 64-bit operating systems to accommodate more RAM. But unlike 32-bit versions, 64-bit Windows doesn't include 16-bit emulation. That means it can't fool a Windows 95 application that's searching for recognisable libraries in order to install itself correctly. The same goes for today's graphics cards and processors. It isn't that they're inherently too powerful for old software, but that the old software can't interpret and harness their power correctly, because they don't understand the drivers installed.


1996's *Tomb Raider* was among the first games to need a discrete graphics card, so it's hard to run in a virtual environment.

Unfinished business on the last level? DOSBox makes games from the *Commander Keen* era easy to run.

The stumbling block for one particular vintage game might be DOS, driver support, missing libraries, security issues, or incompatibility beyond 16-bit systems, but the root cause is fairly universal – it's the software environment. The obvious solution is to modify that software environment so the old game has enough information and security privileges to function. And that's something you can go big or small with. Since we're doing this methodically, it makes sense to begin with the small measures, such as patches and DOSBox, and work up to more drastic solutions, such as running a virtual Windows XP machine.

SCOUR FOR UPDATES

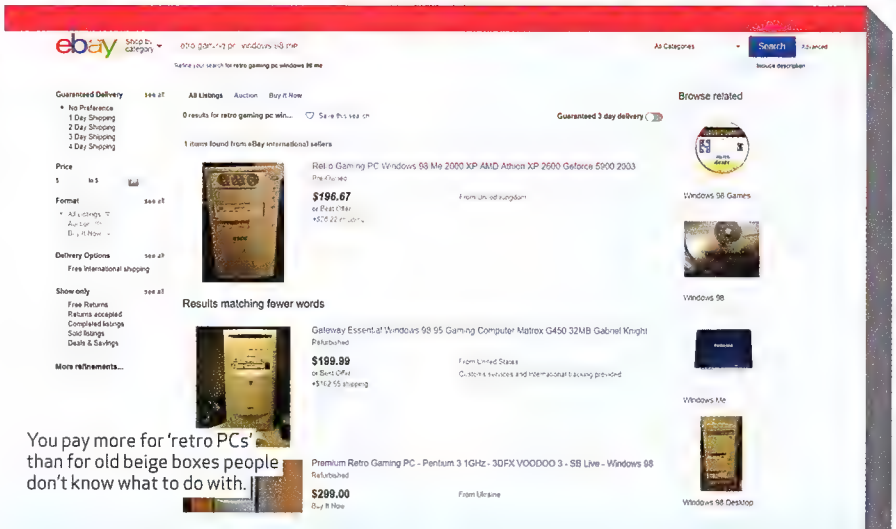
If a game installs on your PC but won't run, first check online for official developer patches, and unofficial patches created by users who experienced similar issues. Perhaps you'll strike lucky with a game like *Vampire: The Masquerade – Redemption*. First released in 2004, it's long since been regarded as a cult classic, but shipped with more bugs than a mail order ant farm. Developer Troika was still releasing patches for it five years later, and the community took it even further with an unofficial patch, which still receives updates in 2017. Try the original disc, and you'll have problems, but with those two downloads, it runs perfectly on Windows 10.

Elsewhere, community modders have addressed issues pertaining to entire game engines, fixing a whole suite of titles in the process. Black Isle's Infinity Engine hosted many of role-playing's all-time greats, such as *Baldur's Gate I* and *II*, *Icewind Dale* and *Planescape Torment*, but relies on Microsoft's defunct DirectDraw API, and thus has all manner of issues on modern machines. Aqrit's DDrawFix resolves those issues in nine games with one 5MB download. There are other solutions, but this is certainly more elegant than running an entire OS in a virtual machine just to access DirectDraw.

COMPATIBILITY MODE OPTIONS

Windows doesn't have a great reputation for the efficacy of its compatibility mode, but in certain circumstances, a checked box here and a drag-down menu option there might be all it takes to solve your problem, whether it be installing or running the old game in question. When you right-click on a program or installer, and navigate to the compatibility tab, you'll see several options to emulate different Windows versions and alter display settings. When you run an application in compatibility mode,

Rogue Spear is in an awkward time bracket: too old for Win 10, too new for DOSBox. Still, there are ways to coax it alive again.



You pay more for 'retro PCs' than for old beige boxes people don't know what to do with.

Doing it the hard way

Depending on your motivation for coaxing an old game back into operation, simply getting it up and running on your current machine might not satisfy. A 4K HDR display might do wonders for your Steam library, but it only serves to highlight the shortcomings of a game designed to run at 640 x 480. And there's something a bit strange about playing *Quake* with an RGB mechanical keyboard and a wireless mouse, when all is said and done. When you feel that the modern technology ensconcing your old software is detracting from the experience, there's only one thing for it: a retro gaming PC build.

A word of warning, though: this can be costly if you're not smart about it. Perhaps it's not a big surprise that giant beige boxes with Pentium IIs and Voodoo 2s are a thriving cottage industry on eBay — everyone has one in their attic or garage, and for some people, the only way to enjoy old games is in situ. But their appetite for tobacco-yellowed Dell keyboards has driven prices well beyond what one might reasonably expect, so avoid searching specifically for "retro gaming PC" items. If you instead search for "Windows 98 PC", for example, you'll find listings for near-identical machines that don't carry a premium for their trendy vintage appeal.

It is worth buying entire PCs in one package, though, rather than trying to source everything component by component. Unless you've been reading up on motherboard/CPU/RAM/GPU compatibility of yesteryear in your spare time, it can be a nightmare to find parts that play nice with each other, or even function at all. Lastly, if you're buying a CRT screen, look for photos of it in operation to check it hasn't demagnetised over time.

Abandonware, all ye who enter

Before even beginning to wrestle it into working, the act of acquiring an old PC game can be tricky in itself. Physical media drives are an increasingly rare sight on modern machines, and there's every chance you threw all your old games out years ago. It might be tempting to hunt for a disc ISO file of some forgotten treasure on an abandonware site, but before you do, it's worth knowing the legality of those actions, and what the term abandonware means.

Essentially, the term defines a legal no-man's-land in which a product's copyright might not have expired, but since its owner no longer supplies it for legal purchase or supports it, it 'abandons' copyright enforcement. It's safe to assume Activision doesn't have a legal team pursuing all those who download ISOs of its 1998 shooter *SiN*, for example, but that doesn't mean it's legal to do so. Real-world example: since Microsoft officially stopped supporting Windows XP in 2014, numerous sites have offered it for free, and none has faced legal action.

So if you own a physical copy of a certain abandonware game, but no longer have a CD-ROM drive with which to install it, you're still not technically within your rights to download a cracked version online. But since it can't be purchased new elsewhere anymore, the copyright holder is unlikely to penalise you. If the company that holds the copyright no longer exists, you're on even safer ground, and if the original software was distributed under a shareware licence (like the first third of *Doom*), well, the feds probably aren't tailing you day and night and preparing to haul you off to jail. Shareware is fine. The important thing is to check whether something really is abandonware before downloading.

Sid Meier probably isn't going to turn up irate at your door when you download *Civilization I*.

They really were the salad days, weren't they?

you're telling your current version of Windows to lie to that application, and it does so by placing a layer of alternate code, known as a shim, between the application loader and Windows. File paths are translated from new to old, so C:\Users\You\Documents becomes C:\Documents and Settings\You\My Documents. It modifies the functions of certain .dlls so the application returns the expected information. For example, the GetVersionEx function used to determine which version of Windows an application's working with would return data from the shim, rather than the true kernel32.dll's information. In other words, when the application asks "Which version of Windows is this?" compatibility mode steps in and says "Windows XP, we promsie!" before your actual OS has chance to blurt out "Windows 10," and give the game away.

In reality, setting the right compatibility mode options can often be part of the solution, but it's rarely your one-stop shop. As a rule of thumb, it's best to start by selecting the predominant OS at the time the game was released (Windows 98 for *Half-Life*, let's say), and running as an Administrator. This helps the application do what it needs to without Windows stepping in and halting it at an unexpected juncture. From there, you can experiment with 256 colours and 640 x 480 resolution limiting, but it's often best to move on and look for other solutions, rather than troubleshooting exclusively in the compatibility tab.

DOs AND DON'Ts

Paradoxically, the further back you go with PC games, the easier it becomes to run them on modern machinery. That's in large part thanks to DOSBox, which emulates an Intel x86-based system, complete with graphics and sound cards, mouse support, and a modem. DOSBox should be the first port of call when running any pre-Windows XP game, which means it opens up about 20 years of gaming, from the Commander Keen days to late '90s gems designed for DOS-based Windows. Since it's effectively a virtual machine, and you probably don't have a floppy disk drive in your machine, you need disk image files of the games you want to play. DOS games are generally considered abandonware now, so although it isn't legal to download them, it isn't likely to get you into trouble (see 'Abandonware, all ye who enter', left).

DOSBox works by mounting a virtual C drive created by the user, then navigating around using command prompts. For example, C:\DOSGAMES becomes your DOSBox's virtual root drive with the command line `mount c c:\dosgames`. For convenience's sake, it's worth keeping all your DOS game image files within this directory, each in individual folders. The 'cd' command changes directory, which means you can type "cd [game name folder]" to navigate to your chosen game, then type the executable name to run it. Of all the methods available, DOSBox is one of the easiest and most reliable, and only requires a few command lines to get things up and running. Its limitations make themselves apparent when running 3D games that were considered demanding at the time, such as *Tomb Raider*, *Quake* or *Carmageddon*. DOSBox runs these using its own software renderer, so for more advanced graphics, you need to seek out a 3DFX/Glide emulator designed for use in DOSBox. Some custom builds of the program, such as DOSBox SVM Daum, come with Direct3D, Glide and other advanced features baked in, so are the best bet for running later DOS games that made use of graphics cards. Ah, the Voodoo days – brings a tear to the eye. And just to hammer the point home, don't rule out DOSBox if you're trying to run a game that was released for Win 95 or Win 98 – they were DOS-based OSes, after all.

Classics like *Doom* don't need much to get running, thanks to Steam and community patches. Mouse support — what a treat!

VIRTUAL INSANITY

If you want to take this vintage gaming thing to a greater extreme, it's time to consider running a virtual machine with an older OS installed. Broadly, this isn't too different an approach from running DOSBox, but if you find yourself playing a lot of games from that awkward post-DOS, pre-Win 7 era, it might end up being more convenient. Plus, there's the heady nostalgia hit of seeing the old OS's desktop, and enjoying all the sound effects — remember when performing almost any action on a PC came with its own bespoke sound effect?

VirtualBox is the go-to application for this. It's relatively easy to install even dusty old Windows 3.1 on a virtual machine, complete with the required virtual hardware, although you either need an install disc and product key for the OS, or a disk image. Once again, we're in the murky waters of abandonware here, but you can find Windows XP and older versions for free online, and Microsoft hasn't pursued any legal action against their distribution.

It's certainly preferable to be greeted by a familiar old interface when booting up games than it is to deal with DOSBox's black and white prompt windows, but VirtualBox does have something of an Achilles heel: 3D graphics support. Its native support is 'experimental' (read: doesn't really work with games), and its developers have long maintained that if the community wants 3DFX/Glide virtualisation, it's up to them to open-source it. Some members of that community have done exactly that (VirtualBox refers to this as Guest Addition content), but it's not a simple task to install it, particularly when working in older operating systems. Having installed your OS via disc or image, restart in safe mode with networking, navigate to the Guest Additions file on VirtualBox's site, then unzip and install it. Sounds simple but if you're on Win 95, there are many compatibility hurdles to overcome when using an unzipper program or downloading the file. Even when successfully installed, 3D acceleration can be prone to crashing in VirtualBox, and has major performance issues that will impact your enjoyment of the game. If you had your heart set on experiencing old games through a trusty old OS, though, there is another way.

PARTITION LIKE IT'S 1999

Yep — partitioning your storage drive and installing an older operating system on to it might do the trick. This is overkill for the vast majority of troublesome retro games, because it's a complicated task that risks data loss if performed incorrectly. But if you really want those old Win 98 themes and your favorite games, create a partition on your chosen disk, and mark it as active by navigating to the Boot tab in Windows System Configuration, highlighting the desired partition, and selecting 'Set as default'. Then reboot and use an old OS disk to install it to the partition; **thpc.info** has a clear step-by-step guide on how to do this. Beware, though: Windows 98 and older won't have a clue what to make of your modern hardware. You will have countless driver issues and ACPI conflicts. You will have to spend hours getting it to recognize your graphics card. But for some, the satisfaction of achieving a resolution beyond 640 x 480 when those issues are resolved is reward in itself.

Summoning the gaming greats of yore can be a knotty problem, then, and there are many ways to untangle those knots. If the game in question falls under the DOS era, DOSBox should be the first port of call; if it doesn't, try searching for patches and fan fixes. Next, try compatibility mode. And if all else fails, well, your parents might still have that old bomb of a tower in the attic... ■

Console yourself (actually, don't)

Creating an artificial software environment in which a program's tricked into running successfully is one way to describe the resurrection of old PC games. It's also one way to describe console emulation on PC, which has a history as long as it is illegal.

Its origins date back to 1990, when programs such as Family Computer Emulator v0.35 allowed a handful of NES games to run on PC. Since then, almost every console has been emulated on PC, and even Nintendo's DS, with its unique control options, joined the ranks. As technical accomplishments, they're impressive, and there's a subversive thrill in seeing another platform holder's ident appearing on a PC monitor. The key difference between using old PC games on a new PC and using old console games on a new PC is that you're breaking two sets of copyright laws when you do the latter. Consoles are closed platforms, and their games are licensed strictly for use on that very specific hardware. What constitutes a PC is open to interpretation, when you factor in the Raspberry Pi, Steam OS machines, office workstations and quad-SLI gaming rigs. What constitutes a PlayStation 4 is not. There haven't been many legal cases, but when Sony tried to sue two PS1 emulators in the 1990s, an uneasy accord was established: as an emulator doesn't re-use code, it's not illegal. The games, however, are.

The legality gets trickier when considering discontinued platforms. Arguably, since the Sega Saturn was discontinued long ago, it can be considered abandonware (along with its software library). But what if the platform comes back to life, as with Nintendo's SNES Mini? Steer clear, and concentrate on PC gaming's voluminous library instead.

Tekken 2: Best on the console it was intended for, however possible it may be to run on PC.

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HOLIDAY PI PROJECTS

Alex Cox reveals diverse ways to give the single-board computer a job and make it earn its keep.

There's a big problem with the Raspberry Pi, and that's the price. It's too cheap. $55 might make it accessible to the widest possible audience, but it also makes the Pi a perfect impulse buy – and don't even get us started on the gumstick-sized, Happy Meal-priced Raspberry Pi Zero. Low cost, tiny size, minimum appreciation – and that's a crime. There are thousands of perfectly capable Raspberry Pis in drawers and junk boxes across the world doing nothing but collecting dust, because their owners didn't have a plan. It's time to change that.

So dust off that unloved hardware, put visions of the slightly underwhelming Raspbian desktop experience behind you, and stop worrying about the dark depths of Linux. Achieving everything we're going to show you here is plausible for just about every user, command-line veteran or not, and every one of these potential projects will put your Pi to work around your home.

Maybe it'll find its niche tucked away next to your router, silently earning its keep as part of your network lineup. Maybe you'll be able to make it part of your home entertainment setup, loudly working as a media streaming box. Perhaps you'll even add hardware to your Pi, taking advantage of its extendable architecture to turn it into something more. Every one of these ideas is the start of a new journey. Each aspect is yours to personalise, to improve, to expand on.

Whatever you decide to do with it, we do have a key recommendation: Ensure you're supplying power to your Raspberry Pi with an appropriate USB power supply. If you don't feed it the 2.5 amps it desires, you're likely to get severely degraded performance, but be careful to buy a quality PSU. We've seen (and bought, and safely disposed of) some horrific budget wall warts that look as adept at starting a house fire as they are at juicing a single-board computer.

Many of these ideas will see your Pi powered up at all times, so something safe, efficient and reliable is a must.

Networking

THE RASPBERRY PI IS A GREAT DEVICE TO TUCK AWAY ON A NETWORK. IT'S SILENT, IT DRAWS LITTLE POWER, AND IT CAN ADD THE SAME FUNCTIONALITY TO YOUR HOME SETUP AS MANY RACK-MOUNTED APPLIANCES DO TO LARGE BUSINESSES. DON'T EXPECT ENORMOUS THROUGHPUT OR THE CAPABILITY TO HANDLE MASSIVE AMOUNTS OF TRAFFIC, BUT THE PI IS THE PERFECT COMPANION FOR A HOME NETWORK.

1 Build a BitTorrent box

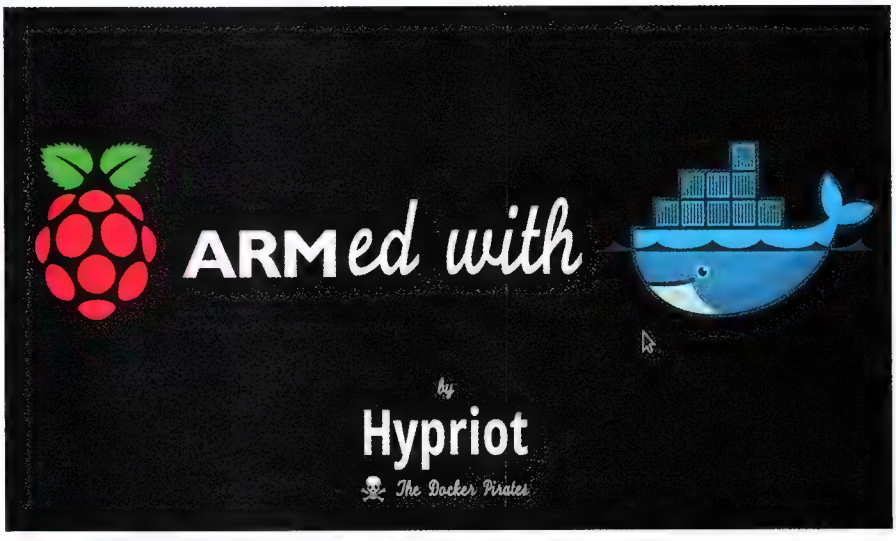
Grab yourself some storage — an external hard drive or large USB stick — and hook it up to your Pi, because it's time to fill it with Linux ISOs and historical artifacts from **archive.org**. Using a Pi as an always-available torrent client makes sense; the protocol is based on sharing and availability, but leaving your main PC ramping up your electricity bill isn't the right way to go about hosting that data. Run Raspbian, install torrent client Transmission with: `sudo apt-get install transmission-daemon` ...then immediately stop it with: `sudo service transmission-daemon stop` ...so we can edit its configuration file. Run: `sudo nano /etc/transmission-daemon/settings.json` to do so.

Find the line that says "rpc-whitelist" and add a comma after "127.0.0.1" followed by — if your network hands out IP addresses — "192.168.1.*" and tweak that address range if required. Then head to "rpc-authentication-required" and change its value from 'true' to 'false'. Exit Nano with 'Ctrl-X', then Y and run `sudo service transmission-daemon start` to set Transmission running again.

You should now be able to log in to Transmission's web interface from any machine on your network, by pointing a browser at, for example, 192.168.1.2:9091, switching the IP address for that of your Pi.

2 Develop New Embedded Systems

You'll need to get a little hardcore for this one. Nard — Not Another Raspberry Distribution — is, as its name suggests, not actually a distro at all. It's a development kit for embedded systems. Install it on an SD card, and your Pi will boot the entire OS into RAM, leaving you free to remove the SD without damaging the system. You then get a truly headless box to work with as you wish, logging in through a web interface, adding packages via an SD card, or — if it's misbehaving — communicating through its USB null modem connection. You're then free to build whatever system you require from its wide selection of lightweight apps, or by making use of the Debian compatibility layer. **arbetsmyra.dyndns.org/nard/address** for that of your Pi.



3 Run pre-packaged applications

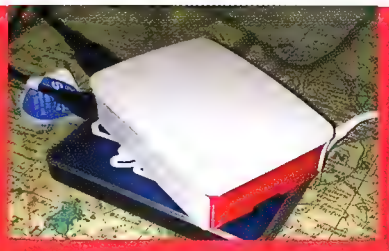
Nard a little too complex for you? How about trying out Docker, and using its containers to install full-featured web apps on your Pi with no configuration? You can't run too many concurrently on the Pi, because each individual container's VM snatches some of its limited system resources away, but something such as ResinOS (**www.resinos.io**) or HypriotOS is the perfect way to throw up a quick file server, database, or web stack as and when you need it. The fine folks at Hypriot have even built a number of useful, shaved-down, Pi-compatible containers for tons of tasks, which you can find at **hub.docker.com/u/hypriot**. Maybe also check out **www.hypriot.com**.

4 Set up a PBX

A PBX — or switchboard — is a great thing to play with. While you can hook up a physical phone line to your Pi via hardware, it's more practical to route a SIP-linked number (from the likes of Skype) or a Google Voice account, which translates PSTN to VoIP for you. Asterisk, a seasoned PBX, can route calls through your home, deal with conference calls and more — and the inclusion of the FreePBX web front end makes its dedicated distro more fathomable than setting it up from scratch. Go investigate at: **raspberry-asterisk.org**

5 Host a website

There's a standard stack of packages used to run a basic website: Linux, the Apache webserver, MySQL to handle the database side of things, and PHP to interact with that database. Setting up a LAMP stack isn't difficult — you can do it with `sudo apt-get install lamp-server` on Raspbian — but with one on your Pi, you can forego the cost of server hosting, and take full control over what you install and what you put online. Redirect web traffic to an open port on your home network with a service such as Dyndns.org, and you're set, though the Pi can only handle minimal traffic. See more: **apache.org**



6 Build a file server

If you're leaving a Raspberry Pi running at all times, it might as well make itself useful. Setting up a Samba share means you (and other users of your network) can store files on it, and because Samba incurs little system overhead, it's realistic to install it on a machine that's otherwise dedicated to a different task. Open a terminal, and type `sudo apt-get install samba samba-common-bin` to install it.

Next, `sudo mkdir -m 1777 /share` creates a shared directory in the root of your SD card, gives everyone permission to read and write to it, and uses the sticky bit (the '1' in '1777') to stop it being deleted. Run `sudo nano /etc/samba/smb.conf` and add the following to the config file:

```
[share]
Comment = Shared folder
Path = /share
Browseable = yes
Writeable = Yes
only guest = no
create mask = 0777
directory mask = 0777
Public = yes
Guest ok = yes
```

Set up a password for your share with `sudo smbpasswd -a pi`, restart Samba with `sudo /etc/init.d/samba restart` and you're all set to go. On a Windows machine, you should see a machine called 'Raspberrypi' in the Network section of Explorer — open it, and you'll find your shared folder.

7 Pen-test your devices

How vulnerable is your network and the machines on it? Penetration testing distros such as Kali Linux aim to give you all the tools you need to hammer your own hardware. And we do mean your hardware, because this entails turning your Pi into a toolkit that could cause chaos when plugged into any other network. Like taking a crowbar to a windshield, it's liable to land you in jail if that windshield doesn't belong to you. Kali (**www.kali.org**) is a mature pen-testing distro, with over 600 tools for everything from vulnerability exploration to wireless attacking and digital forensics.

8 Route your network traffic

Let's be blunt: a Pi isn't the best choice of hardware for a router; its Ethernet port sits on its single USB 2.0 bus, bottlenecking its data allocation between all devices, so you're likely to top out at 50Mb/s throughput. That said, a lot of routers aren't the best choice for a router, as they're filled with dumb software that wouldn't know a packet from a hole in the ground. OpenWRT (**www.openwrt.org**) is replacement router firmware that gives you pinpoint control; if your hardware doesn't support it, switch into modem mode, and send traffic through OpenWRT running on a Pi.

9 Protect your network

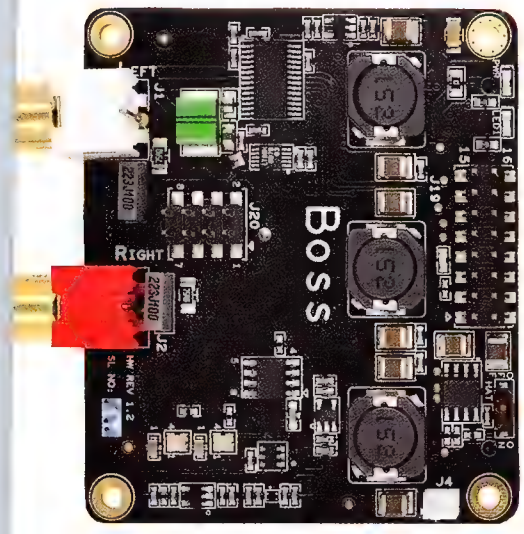
The Windows firewall is a formidable foe, but it's useless at protecting anything other than the machine it's on. So your phone, tablet and IoT fridge are all vulnerable. Unless you put something in the way, and don't mind sacrificing even more data than you would with OpenWRT. Using a USB Ethernet dongle, you'll be down to 25Mb/s per port. Forgive a little sluggishness, though, and a Raspbian-equipped Pi running Gufw (**www.gufw.org**) is all you need to fend off an uncomfortable number of packet sniffers. Adding Pixelserv (**proxytunnel.sourceforge.net/pixelserv.php**) also blocks ads network-wide.

10 Create a VPN server

Hosting your own Virtual Private Network solves two key problems when you're away from the sanctuary of your home setup — it grants you access to your files and devices as though you were there, and it encrypts your traffic, obfuscating it from anyone who might be listening in on whatever seedy public Wi-Fi network you've managed to connect to. Leaving a home-based Pi running the OpenVPN server (you'll find it in your chosen distro's package manager or at **openvpn.net**) should do the trick, although RSA key configuration and the amount of IP table fiddling that's required mean this isn't the most trivial task.

Fun

ALTHOUGH THE PI 3'S GPU RUNS AT BETWEEN 300 AND 400MHZ, IT'S REMARKABLY POWERFUL WHEN YOU NEED IT TO BE. A PI ATTACHED TO THE BACK OF A MONITOR DISCREETLY TRANSFORMS THAT SCREEN INTO AN ALL-IN-ONE MACHINE, AND THE RANGE OF SINGLE-SERVING ENTERTAINMENT APPLICATIONS THE PI CAN PULL OFF IS JUST REMARKABLE. GRAB AN SD CARD, INSTALL AND ENJOY YOURSELF.



11 Network audio player

Easily enhanced with an add-on DAC — the Allo Boss gives a massive sound and attaches to the Pi's GPIO pins — a Pi makes an ideal network audio player. There's a couple of ready-to-rock distros that aid in setting up support for the likes of Spotify, DNLA audio, web radio stations and all the formats you could want. Our pick, Volumio (**volumio.org**), bills itself as "the open audiophile audio player", enabling you to fire off tunes using its comprehensive web interface on your phone or PC, and even offering its own hardware, including amps that do away with the need for anything beyond a pair of passive speakers.

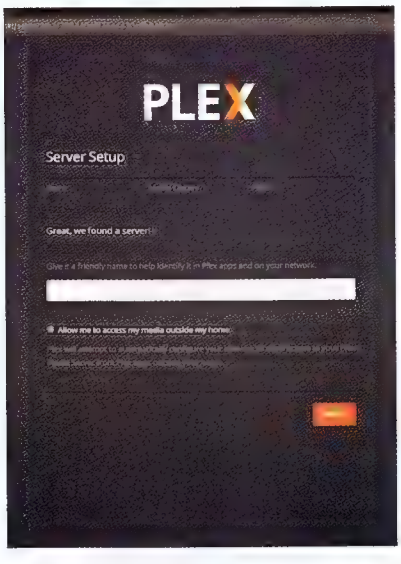
12 Remote-control the Raspberry Pi

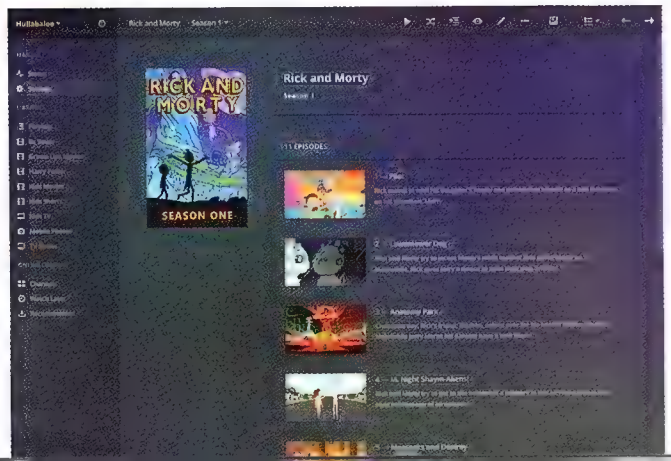
It's fairly easy to attach wireless peripherals to the Raspberry Pi, and most should work without special drivers. Just plug in the USB portion and go, or use `sudo apt-get install bluetooth bluez blueman` to install Bluetooth management tools on the Raspbian GUI, then connect your devices from 'Menu > Preferences > Bluetooth Manager'. There's a command-line Bluetooth interface, which can be a bit more reliable, but it's tricky to get started with. If you're setting up your Pi to use as a living room media box, a combined mini keyboard and trackpad, such as the second-generation backlit Aerb is a great choice.

What if you want to get a bit more granular and old-school — not to mention technophobe-friendly — with your remote controlling? MSL Digital's RemotePi Board (**msldigital.com**) sits on top of a few of your Pi's GPIO pins, and is fully configurable to accept commands from whatever IR remote you point at it. MSL paints the RemotePi primarily as a power control board, fixing the key problem with the Pi's design, and letting you gracefully switch your media box on and off with a remote.

13 Plex server

The more we cut the cord, the more we need other options for our TV viewing pleasure. If you've already amassed a large media library, Plex (**plex.tv**) is a top choice — it's super-slick, fills up your library with cover images, theme songs, and episode information automatically, and requires very little in the way of technical knowledge to set up. It even streams online to your mobile devices. There's a catch, though: running a Plex server on a Pi isn't really feasible if you want to enjoy your media in anything other than its stored resolution and format, because even the Raspberry Pi 3 doesn't have the required muscle for transcoding video.





14 Plex player

Yes, we literally just talked about Plex, but there's good reason to separate out the tasks of using your Pi as a server and as a player: It's far, far better at the latter. A Raspberry Pi 3 can easily handle 1080p video at 60fps, which is adequate for all but the most eagle-eyed 4K-fancying viewers. Install a distro such as RasPlex (**rasplex.com**), and you'll be all but ready to go. Just connect to your TV, log in to your server, and you'll be playing back media in no time. All you need is a way to control it, and you'll find a few options above in the 'Remote-Controlling the Raspberry Pi' box.

15 Emulate classic consoles

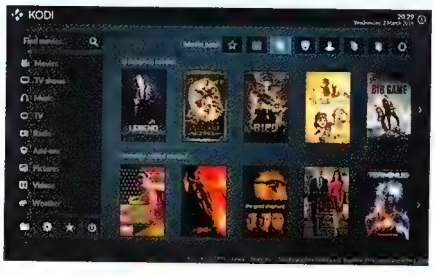
Anyone with half an eye on the Raspberry Pi has probably heard of this one already, but we think it bears repeating: RetroPie (**retropie.org**) is a simply incredible package of pre-configured, super-accurate console emulators, with a gorgeous front end supplied by EmulationStation. Most are built on top of the Libretro engine, which ties a number of different systems into a single package, meaning that you can make global changes to settings, which are automatically reflected across all platforms. Grab a USB adapter for your favorite set of console controllers — or just plug in a wired Xbox pad — and you'll be away.

16 Keep up with Kodi

Kodi is a big name in the streaming world, and not necessarily for the right reasons. Forget piracy, though: Kodi (once called XBMC and spawned from a project that turned the original Xbox into a media centre) really ought to be known for how easy it makes getting a media box up and running. It's supported by just about every Raspberry Pi distro. On Raspbian, you can install it using the following pair of commands in a terminal window:

```
sudo apt-get update
sudo apt-get install kodi
```

If that sounds too much like hard work, there is, like most of the projects we've talked about, a single-serving option to get a working Kodi installation running from scratch. In fact, there are several for you to choose from. OpenELEC (**openelec.tv**), the slightly more open source LibreELEC (**libreelec.tv**), OSMC (**osmc.tv**), and Xbian (**xbian.org**) all include Kodi pre-installed and configured, and are perfect if you're dedicating a Pi to the TV task; Kodi runs as both media server and player, so make sure you have some storage available for your content. You can also install Kodi to run through RetroPie, which is an immensely useful option.



17 Master Minecraft

There's a version of *Minecraft* for the Pi (**minecraft.net/en-us/edition/pi**), which is free, and a great way to get stuck into a bit of programing if you decide to wade into the code and hack it. You can also jam the full version of Minecraft on to a Pi 3 (**www.raspberrypi.org/forums/viewtopic.php?t=186547**), though it's a little experimental. Your Pi may be better put to use as a *Minecraft* server; there's enough power to host a few concurrent players of the full version, and while it's a little slow to generate new chunks, it's adequate. For better performance (with fewer features), try Cuberite (**cuberite.org**), a multi-platform server designed to be lightweight.

18 Bring back DOS

Translating x86 instructions to the RISC structure of an ARM chip takes a lot of processing power. It is possible to use virtual machine environment QEMU (**qemu.org**) to emulate a 486-class PC on a Pi, and you can even run a treacle-slow Win 98 install on top. But that's ridiculous. Instead, try the ARM port of DOSBox (**dosbox.com**), so you can resurrect the classics without having to dredge up a machine that'll deafen you and double your electricity bill. Just run `sudo apt-get install dosbox` from the Raspbian package manager. To get really authentic, dig out that old box of floppies, and use a USB floppy drive to read them.

19 Play arcade games

The Raspberry Pi's ARM architecture might not lend itself to some of the applications that x86 machines handle with aplomb, but it's absolutely perfect for emulation. So let's take a trip through the old school by running classic arcade games on the miniature marvel. While it's not been updated for a while, we place PiPlay (**piplay.org** formerly PiMame) at the top of the list for running the collection of legal MAME ROMs available from **mamedev.org/roms**, and only those ROMs. We couldn't possibly say how well it runs any other ROMs.

Hardware

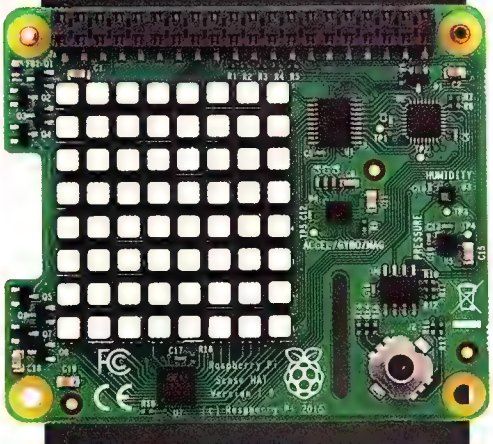
THE RASPBERRY PI WAS DESIGNED FROM THE VERY BEGINNING TO GIVE YOU CONTROL. IT'S BANK OF GENERAL PURPOSE INPUT/OUTPUT (OR GPIO) PINS ARE THERE SO THAT YOU CAN READ IN SIGNALS FROM SENSORS, FIRE OUT SIGNALS TO DEVICES, AND EXTEND THE PI'S CAPABILITIES WITH HARDWARE ATTACHED ON TOP (HAT) BOARDS. AND SO YOU SHOULD.

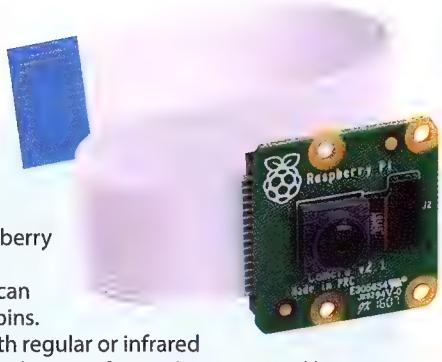
20 Your own project

The Pi is designed as an educational, experimental board. You can use it to follow; there are plenty of projects where others have done the hard work for you. Or you could use it to lead; make something new. Turn that invention in your head into reality.

If this appeals, there's a pair of add-on boards that appeal to the tinkerer. The first is the Sense HAT (**www.adafruit.com**), a combination of sensors (gyroscope, magnetometer, accelerometer and others) along with a joystick, and an LED matrix display. This is the board that made it to the International Space Station as part of the Astro Pi project, and includes a Python library to allow you to access everything the board has to offer.

The other, which has been making waves more recently, is the MATRIX Creator (**creator.matrix.one**). Designed to facilitate quick hardware prototyping, it includes libraries in multiple programing languages, an eight-point MEMS mic array, a programmable FPGA, a bunch of 3D sensors, and a waterfall of connectivity options to interface it with whatever hardware you like.



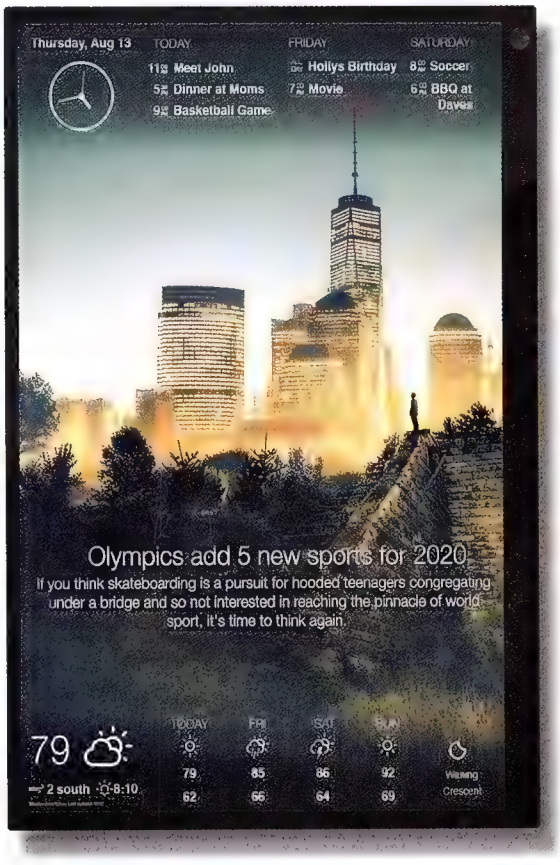


21 Security made easy

One of the first hardware add-ons for the Raspberry Pi was a camera. Indeed, there's even a special header on the board for such a device, so you can hook it up without blocking any of your GPIO pins. The second-generation sensor, available in both regular or infrared flavours, can take 8MP snaps or stream 1080p video at 30fps, and is supported by plenty of software within the Raspbian ecosystem. Add in a bunch of IoT motion detectors and door switches, and you can (with a little effort) build your own home security system that you can monitor from your smartphone. The PrivateEyePi (**projects.privateeyepi.com**) project has everything you need to get started.

22 Wall-mount your Pi

Take an old monitor, a VESA mount, and a Raspberry Pi. Screw the lot to your drywall, and you've got something special: a screen that can cycle through your photos, give you at-a-glance news information, remind you of calendar appointments, and much more. Registering a free account with DAKboard (**dakboard.com**) and setting your Pi to run Chromium in kiosk mode is basically all you need to do. You can customise the display through DAKboard's web interface, and grab additional features such as calendar customization and weather data with a small monthly subscription.

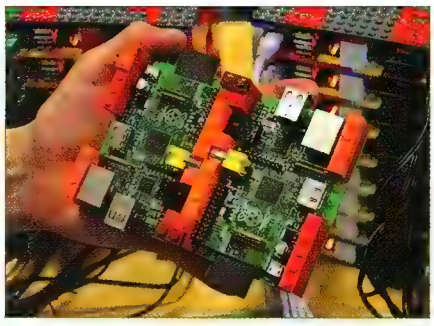


23 Make a magic mirror

You know how good-looking you are. And your mirror knows, too. But what if it knew more, and could tell you information about the day to come while you gaze at yourself? Combine half-silvered glass with a Pi-equipped monitor, and this can be yours. Dutch hacker Michael Teeuw developed the magic mirror in 2014, and it's been replicated by hundreds of enthusiasts since (**magicmirror.builders**), and has spawned modules, tweaks and ideas that can help you develop a custom mirror of your own.

24 Monitor the weather

With only $140-worth of parts — including the Pi at its heart — you can construct a weather station that monitors humidity and temperature, then logs it to a web interface (**raspberryweather.com**). It's a great way to learn a bit of Python, pick up the basics of interacting with sensors, and create a project that you could extend later on. It's not as full-featured as the weather station the Raspberry Pi team gave out to schools (**raspberrypi.org/education/weather-station**), however Raspberry Weather's tutorial is a valuable resource that'll get you going fast.



25 Build a cluster

Earlier, we mentioned the possibility of installing Docker containers on the Raspberry Pi. While they're excellent at getting preconfigured applications running, there's another aspect of Docker that suits the Pi's low cost and low energy footprint very well: Swarm mode. In essence, it's a simple way of setting up cluster computing, which combines multiple physical machines with networking to create a single logical machine. Hook up two Raspberry Pi 3 units as processing nodes, for example, and you'll have eight ARM cores and 2GB RAM at your disposal. Scale it up, and you'll outpace the processing power of the original Cray supercomputers with only a small investment.

Normally, this isn't at all easy, as anyone whose high school computer lab had them set up a Beowulf cluster of tired Pentium 2 machines will attest. Thankfully, the software wizards at Hypriot have developed the Cluster Lab, a super-simple way to set up a Docker Swarm with several Raspberry Pi units. Check out the instructions at **github.com/hypriot/cluster-lab**. In essence, you simply need to flash a specific OS image to each node, tell them they're part of a swarm, and they'll find each other, and work together automatically. Now it's just a question of what to do with your cluster...

26 Upgrade your car

With a Double DIN-sized touchscreen, a Pi and possibly some in-car Wi-fi, you have all you need for an in-car upgrade. Will you use Navit (**www.navit-project.org**) to add a module, and set up your own GPS? Will you entertain passengers with an in-car media centre? Perhaps you want to use your Pi to monitor your engine via your car's OBD-II port using a Bluetooth module? The possibilities are myriad. The guys at iCarus (**www.i-carus.com**) can furnish you with everything from the software (which runs on Raspbian), to individual components, to entire pre-assembled units.

27 Build a robot

Scratch is the Pi's key learner language. You can build complex programs by dragging and dropping elements of code, and filling in the odd variable here and there. But don't take that to mean it's simplistic. You can also use Scratch (or Python, or C) with a hardware control board, such as the Laika Explorer (**project-laika.com**), to interface with motors, servos and sensors, turning your Pi into a full-featured robot. Laika's programing library is packed with all the functions you need to prototype a 'bot, so all you need to worry about is supplying the power. If you plan to give your creation wheels, we recommend an external battery pack.

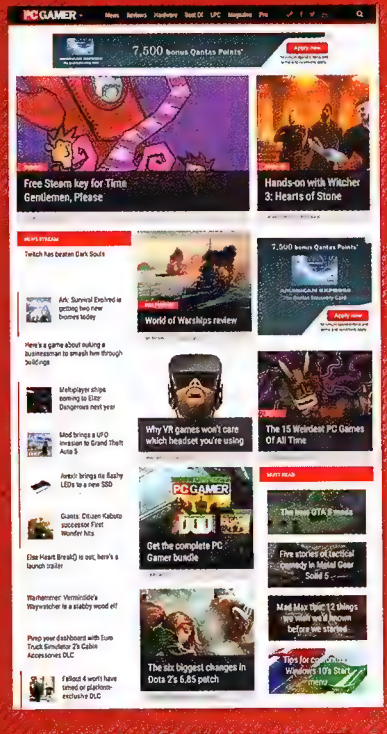
28 Build an arcade machine

If your emulation interests have been piqued by PiPlay or RetroPie, Pimoroni's Picade HAT (**www.adafruit.com**) may be for you. Jam it on top of your Pi's GPIO pins, and you gain a 3W DAC for audio, power routing through its USB port, and screw terminals, enabling you to attach real arcade controls. It comes on its own, or with buttons and a joystick, or as a mini cabinet with monitor all for reasonable prices. Try spending a little more and securing authentic Sanwa or Seimitsu parts from **www.focusattack.com** to build your own.

29 Create a voice assistant

Who needs Google Home or Amazon Echo? People who can't do things for themselves! With a Pi, a suitable microphone, an external speaker and a certain level of patience, you can create your very own voice assistant that uses precisely the same voice service that Amazon uses on the Echo, meaning you have access to all the skills and enhancements that go along with it, and it starts automatically when you power up your Pi. You need to register a free Amazon developer account in order to gain access to the API (**github.com/alexa-pi**) — and, if we're honest, the combined cost of hardware is greater than the price of an Echo Dot, but don't let a silly thing like that put you off. ■

SMARTER COOKIES ENABLED


PC GAMER
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Free Steam key for Time Gentlemen, Please
Hands-on with Witcher 3: Hearts of Stone
World of Warships review
Why VR games won't care which headset you're using
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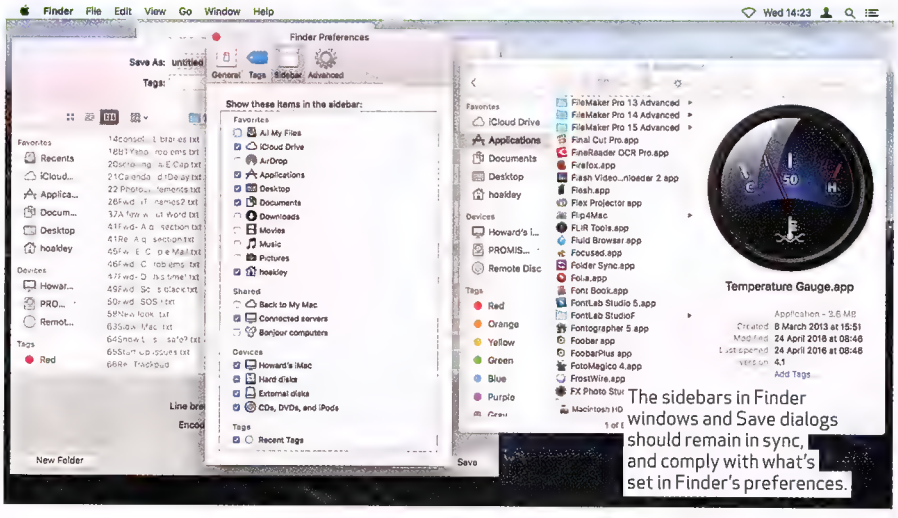
HARDWARE

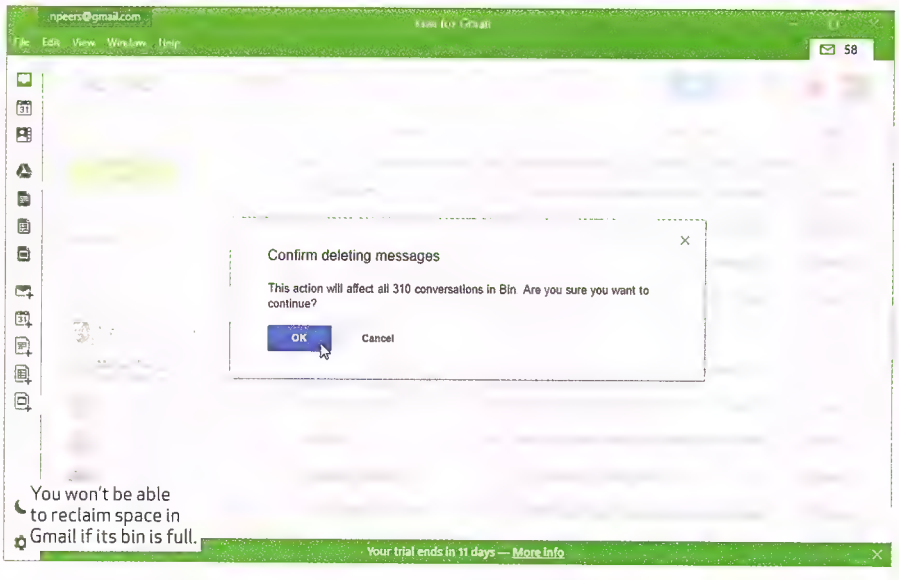
LAPTOP WIPING WORRY

I'm about to remove my laptop hard drive, connect it to my desktop and wipe the drive before returning it to the laptop for a brand-new Windows install. But I've realised that, when I put back the drive, there will be no OEM partition on the drive containing laptop drivers to recognise the optical drive or USB ports, and there's no laptop drivers disc. How would I install these drivers to ensure they would recognise the Windows install disc when I boot?
Gerald Gibson

Your laptop's ability to boot from a DVD or USB drive is not linked to the currently installed OS system. It's handled by your PC's BIOS or UEFI. You can test this now with your Windows bootable USB flash drive. Restart your laptop with the drive plugged in and it will do one of three things: automatically boot to the recovery media; offer you the option of pressing any key to boot from the recovery media; or boot back into Windows as normal. If it goes straight to Windows, restart your laptop again, but look for a message that flashes up on first boot inviting you to press a key to access a boot menu – such as F11 – or enter the BIOS/UEFI configuration tool – typically Del or F2. If the boot menu option is presented to you, press the key and a boot menu will appear – check to see whether your USB drive is listed; if it is, select it and then press Enter to boot from it. If it isn't, check that the configuration tool you're using supports USB booting – if it does, make sure that the USB drive is listed. If it doesn't, you'll need to burn a Windows 10 install DVD using the Media Creation Tool, and then boot from that. **Nick Peers**



The sidebars in Finder windows and Save dialogs should remain in sync, and comply with what's set in Finder's preferences.

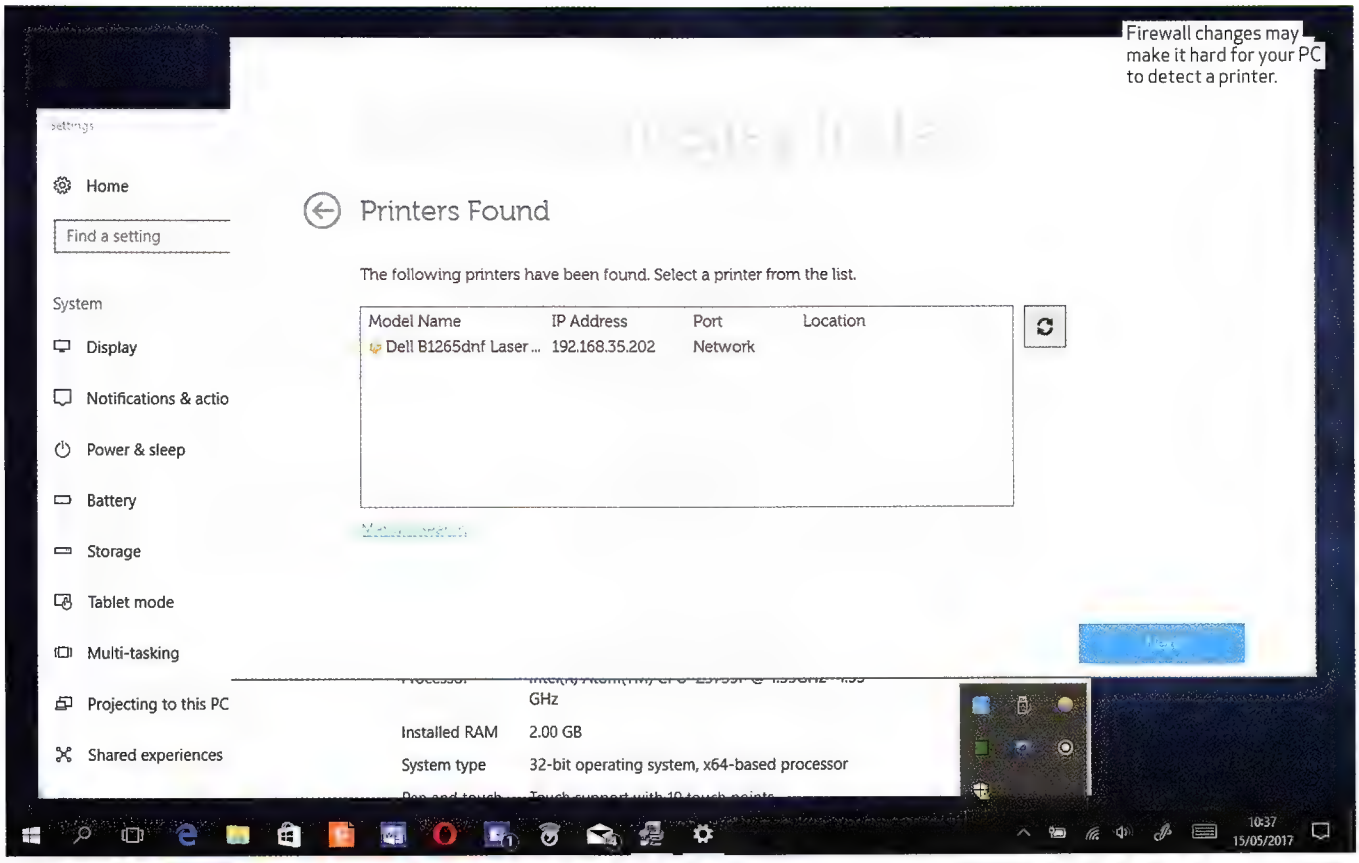

Confirm deleting messages
This action will affect all 310 conversations in Bin. Are you sure you want to continue?
OK
Cancel
Your trial ends in 11 days — More Info
You won't be able to reclaim space in Gmail if its bin is full.

MAC

SIDEBAR FAVOURITES IN DISPUTE

The two versions of Finder's sidebar, listing favourites, devices and so on, have somehow become different on my Mac running OS X El Capitan 10.11.5. Viewed in Finder, that sidebar looks correct, with a single Desktop item. However, viewed in an app's Save dialog, the Desktop item is shown twice under Favourites. Why is this, and how can I fix it?
Janet Goldner

This shouldn't be possible, as both those sidebars are generated by the same code in OS X, and should be identical. To verify that, start an app, create a new document, then open the Save dialog, positioning it on the left of your screen. Then bring a Finder window to the front on the right, so that you can see both sidebars at once. Next, choose 'Finder > Preferences' and click the Sidebar tab. Uncheck the Applications item there; that item should immediately disappear from Favorites in Finder and the Save dialog. Sometimes such preferences get stuck, and trashing the file at ~/Library/Preferences/com.apple.Finder.plist (the tilde means your home folder; in Finder, hold Option and choose 'Go > Library') can allow it to be saved properly. However, the two locations' behaviour should remain consistent and reliable even if the preferences can't be saved properly. If the two sidebars don't behave identically, your Mac most probably still has the remains of an old third-party



"When MailStore deleted your mail from the Gmail server, it didn't wipe it completely; instead the mail was placed in the Bin folder."

utility that modifies Save dialogs, such as Default Folder X. Restarting in Safe mode (hold ß when you hear the startup sound) should disable that to confirm, allowing you to identify and remove those remains.
Ian Sleightholm

EMAIL
GMAIL DRIVE FULL

I followed a step-by-step guide I found online to archive my old Gmail email from before 2015. Everything appeared to proceed smoothly enough — the files are now in MailStore and I chose the option to delete messages on the server, but Google is still telling me I only have 350MB free space. What gives?
Greg Jenner

When MailStore deleted your mail from the Gmail server, it didn't wipe it completely; instead the mail was placed in the Bin folder, where it will reside for the next 30 days until automatically being wiped. If you're confident all the mail you've archived is now accessible through MailStore, go to **mail.google.com** and locate the Bin in the list of folders on the left. Click this followed by the 'Empty Bin now' link at the top of the page. Confirm how many messages will be deleted, then click OK. Be patient while this process occurs; once done, it may also take a little time before your Google account is updated to show the correct amount of free space you have.
Nick Peers

WINDOWS
PRINTER WON'T CONNECT

I'm attempting to re-connect my laptop PC to my network printer after installing the Windows 10 Creators Update. When I run the printer's setup software, however, it fails to find the printer. Do you have any idea what's happening?
Evan Luckett

Evan subsequently revealed that his laptop had 2GB of RAM, and that he had no problem connecting to the printer from his main desktop PC. We investigated the issue and discovered that, due to firewall hardening rules, some network printer software may be unable to detect printers over the network on machines with under 4GB RAM. Microsoft should resolve the issue in an update, but you can fix the issue manually.

Right-click the Start button and choose Command Prompt (Admin), then type the following command and hit Enter:

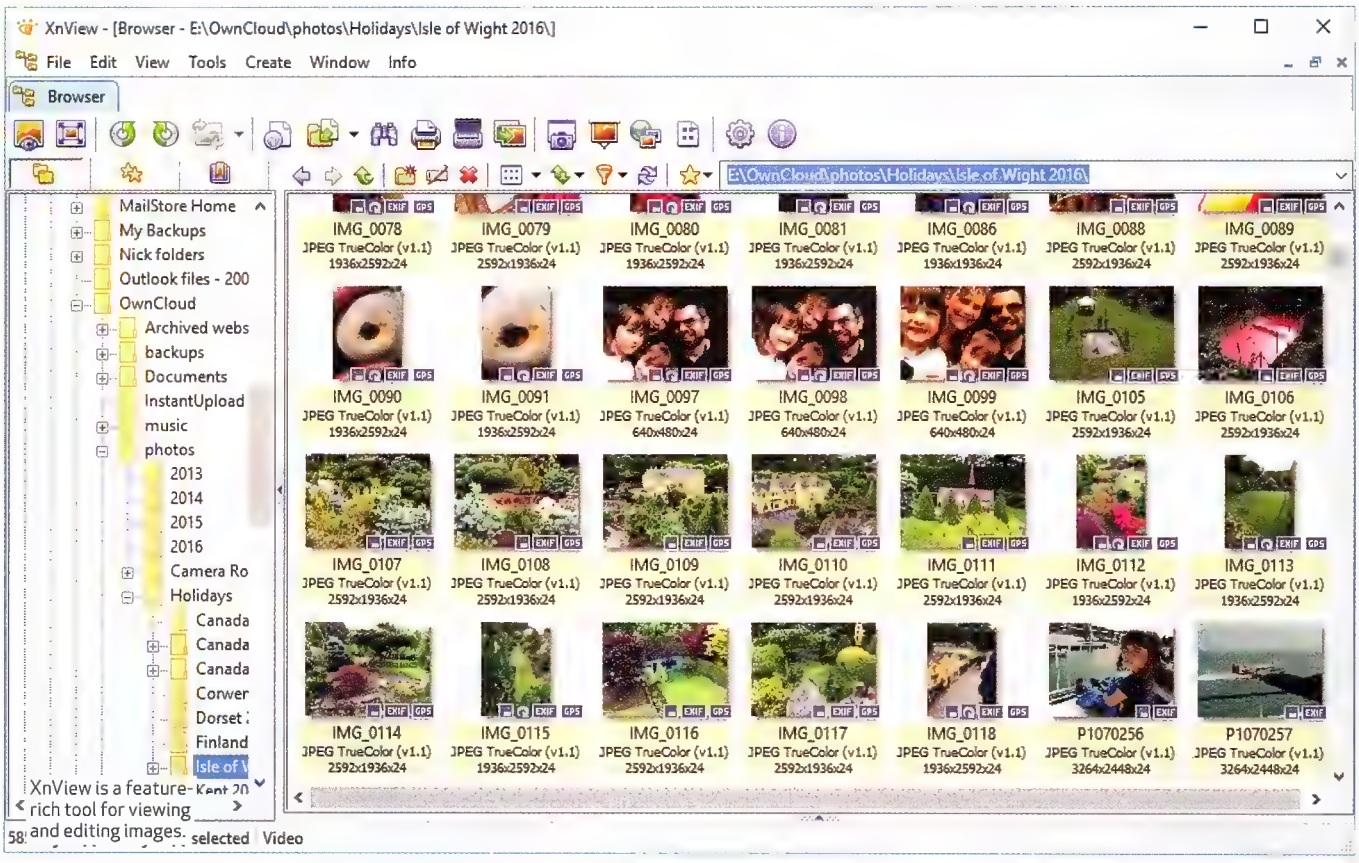
```
sc config fdphost type=own
```

Restart Windows and the printer software should now be able to detect — and install — the printer.
Rob Mead-Green

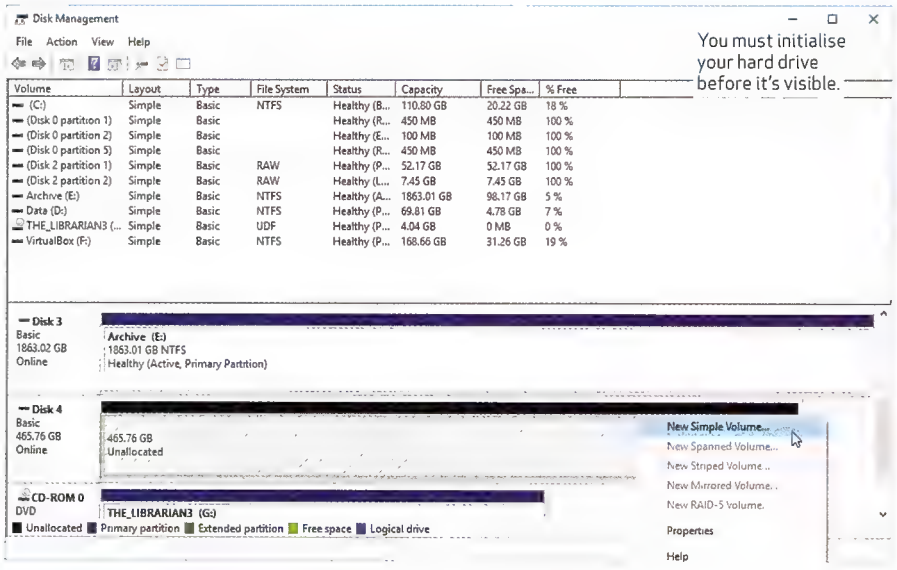
HARDWARE
NEW DRIVE ISN'T VISIBLE

I recently fitted a second internal hard drive to my desktop PC. I've double-checked the physical connections and verified it's visible in the configuration utility that appears before you boot Windows, but there's no sign of it in Windows at all. What am I missing? A driver?
Leonard Green

It sounds like the drive hasn't yet been initialised, which you can do in Windows. Right-click the Start button and choose 'Disk Management', which will list all the drives attached to your PC. You should see your new drive is visible here, but it'll be marked as Unallocated. Right-click this space and choose New Simple Volume. Follow the wizard through the steps to set it up — the default choices will create a single NTFS-formatted hard drive complete with drive letter, ready for you to use.
Matt Hanson



XnView is a feature-rich tool for viewing and editing images.


Disk Management
File Action View Help
You must initialise your hard drive before it's visible.
Volume Layout Type File System Status Capacity Free Spa... % Free
(C:) Simple Basic NTFS Healthy (B... 110.80 GB 20.22 GB 18 %
(Disk 0 partition 1) Simple Basic Healthy (R... 450 MB 450 MB 100 %
(Disk 0 partition 2) Simple Basic Healthy (E... 100 MB 100 MB 100 %
(Disk 0 partition 5) Simple Basic Healthy (R... 450 MB 450 MB 100 %
(Disk 2 partition 1) Simple Basic RAW Healthy (P... 52.17 GB 52.17 GB 100 %
(Disk 2 partition 2) Simple Basic RAW Healthy (L... 7.45 GB 7.45 GB 100 %
Archive (E:) Simple Basic NTFS Healthy (A... 1863.01 GB 98.17 GB 5 %
Data (D:) Simple Basic NTFS Healthy (P... 69.81 GB 4.78 GB 7 %
THE_LIBRARIAN3 (... Simple Basic UDF Healthy (P... 4.04 GB 0 MB 0 %
VirtualBox (F:) Simple Basic NTFS Healthy (P... 168.66 GB 31.26 GB 19 %
Disk 3
Basic
1863.02 GB
Online
Archive (E:)
1863.01 GB NTFS
Healthy (Active, Primary Partition)
Disk 4
Basic
465.76 GB
Online
465.76 GB
Unallocated
New Simple Volume...
New Spanned Volume...
New Striped Volume...
New Mirrored Volume...
New RAID-5 Volume...
Properties
Help
CD-ROM 0
DVD
THE_LIBRARIAN3 (G:)
Unallocated
Primary partition
Extended partition
Free space
Logical drive

SOFTWARE
COMPATIBILITY ISSUES WITH EMBER

I'm still using a wonderful (but discontinued) program called Ember, which I purchased back in the Windows XP days. I've never found another graphic file manager, viewer and screensaver like it, so keep going back despite my best efforts to move on. I've tried to install it now in Windows 10, but am unable to get past a series of setup screens, which keep appearing each time I restart the program. Can you help?
Peter McAndrew

In the past, Peter could complete the setup process by temporarily reducing User Access Control to its lowest level, but this no longer works in Windows 10. Ironically, the actual solution is a lot simpler. When running Ember for the first time, simply right-click its program file or shortcut and choose 'Run as Administrator'. This gives it the one-time access to the Registry it needs to finish setting itself up – once done, the program should run as normal.

While troubleshooting the problem, Ian came across XnView (**www.xnview.com**) as a potential long-term replacement for Ember. It comes in many guises – XnView MP is the most fully featured version, while XNView Classic may have the functionality Ian needs.

All are free for personal use, and can be run as portable applications too.
Cat Ellis

MAC
WHY WON'T SPOTLIGHT INDEX MY DRIVE ANYMORE?

Spotlight indexing has stopped working on my Mac's internal drive. If I remove that drive from under Privacy in Spotlight's preferences, indexing never completes, and my Mac's logs are full of repeated errors about mdworker failing. I've tried forcing the index to be rebuilt, but the problem recurs. How can I fix this?
Simon Simpson

This usually happens because mdworker, the background service which builds the metadata indexes used by Spotlight, is choking on files or folders that it can't cope with. Sometimes messages in OS X's logs reveal which files are causing the problems, so help you work out what to do to eliminate them. They're usually preference lists (plists) or similar, which can be trashed to allow indexing to work normally. When there's no help from your Mac's logs, use the exclude list in the Privacy tab to work out where offending items are. Remove your internal drive from that list, but add back its top-level folders. Take them out of the list one by one until indexing breaks, and repeat this process to narrow the issue down to one or more individual files. If you don't use Spotlight much, you could leave the drive or individual folders that are troublesome excluded. Note, though, that you can't turn off indexing of your Time Machine

System Preferences Edit View Window Help
Wed 14:01
Spotlight
Spotlight helps you quickly find things on your computer and shows suggestions from the internet, iTunes, App Store, movie showtimes, locations nearby, and more.
Search Results
Privacy
Prevent Spotlight from searching these locations:
Click the Add button, or drag a folder or disk into the list below.
PROMISE PEGASUS
Roxio Converted Items
Keyboard Shortcuts...
About Spotlight Suggestions & Privacy
MacBook
Clever detective work in Spotlight's exclusion list can pinpoint items that are getting in the way of indexing.

backups, as Time Machine relies on Spotlight's indexes to function.
Ian Sleightholm

OFFICE
DISPLAY EXCEL DOCUMENTS ON MULTIPLE MONITORS

I'm running Excel 2010, and I want to display two separate spreadsheets on different monitors, but I can't get the files to open in separate windows. Can you help?
Greg Scowen

Later versions of Microsoft Excel than you have do open each worksheet in its own window, enabling you to easily drag one to another display. In Excel 2010, however, you'll need to open your first document as normal in Excel, then press 'Win-R', type "excel" and hit Enter – this should open a new instance of Excel containing a blank document. Choose 'File > Open' to load in your second document, and then drag whichever window you want to the second display. It's a slightly inelegant solution, but it works!
Mayank Sharma

LINUX
MOVING MOUNT POINTS

My desktop distro is Gentoo Linux, which began from a Linux Format DVD! Last year, I decided it was time for a new box. My system is on a SSD and /home is on a Seagate Barracuda with a media adaptor and a hotswap rack. It all works well, with one exception: the hotswap rack drive I currently have is automounted at /media. It's a 1TB drive with two partitions. I'd like this to mount at a location on / I call / hotswap rather than /media. Perhaps you guys have a suggestion on how I can integrate these changeable drives. Changes to fstab have no impact.
Rob Russell

You don't specify what changes that you have made to /etc/fstab nor which desktop and automounter you are using, but /etc/fstab usually overrides any automounter defaults. One thing that you need to be careful of dealing with hotswap drives is that the drive name isn't guaranteed to be consistent. Depending on when you connect it and the order in which drives are discovered at boot, it could have a different device node. The solution is to use an identifier that doesn't change. You can use a filesystem's UUID, which you can read with `blkid` , for example: `$ sudo blkid /dev/sdb1` .

Once you have the UUID, you can add an entry to /etc/fstab like this:

```
UUID=xxxx /hotswap auto defaults 0 0
```

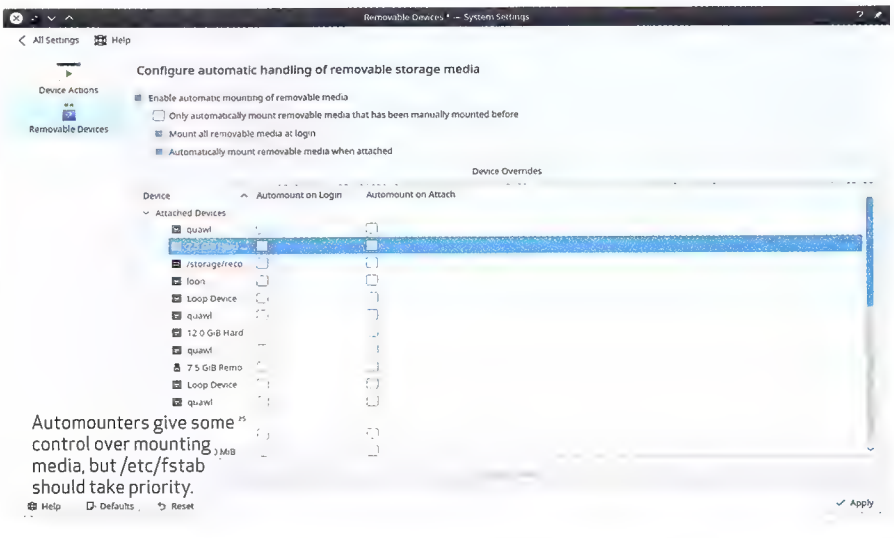
The `auto` in the third field tells the `mount` command to automatically determine the type of filesystem. If you always use the same filesystem on your drives, you can specify it here. If you use different drives in the rack, you will need an fstab entry for each one. The other option is to use filesystem labels. These aren't assigned by default, unlike UUIDs, so you will need to set them up, but they have the advantage of being readable. The command to use depends on the filesystem, for ext filesystems use `e2label` :

```
$ sudo e2label /dev/sdb1
$ sudo e2label /dev/sdb1 data
```

The first command reports the filesystem's label, if any, the second sets it to data. Then you can specify the label in fstab like this:

```
LABEL=data /hotswap ext4 defaults 0 0 .
```

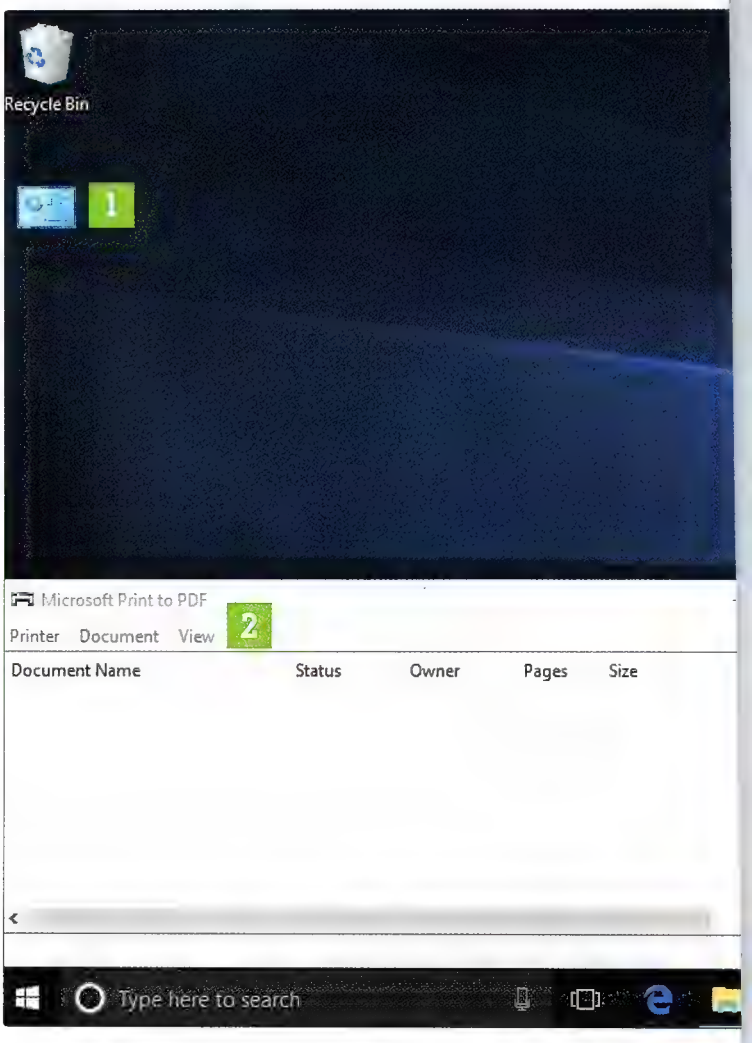
There are similar commands to work with the labels for other filesystems. If your automounter continues to ignore fstab, you should investigate the options for the particular automounter you use. For the KDE desktop you will find this in System Settings, while in GNOME, it is configured in Nautilus.
APC Team



Automounters give some control over mounting media, but /etc/fstab should take priority.

Discover Windows 10's hidden gems

Nate Drake shows how you can tweak your system by uncovering some of the hidden gems and less well known features of Windows.



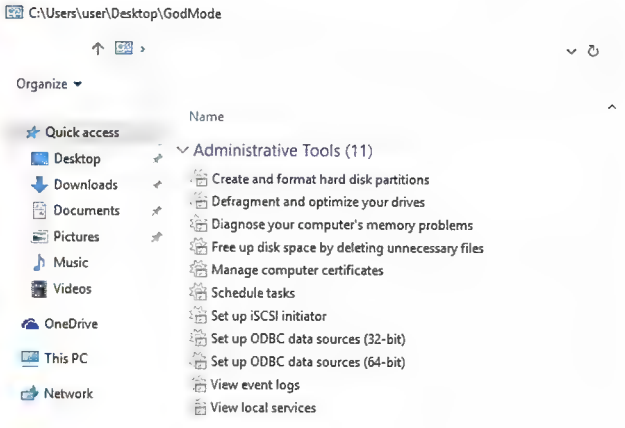
Have you recently switched to Windows 10 and miss some of the features from previous versions? If you upgraded some time ago, are there tweaks you'd like to make to your system? If either of the above true, you have come to the right place! In this guide, we'll so you how to perform some of the actions you may remember fondly, such as showing the desktop, tiling windows and customising your Start menu. We'll also look at new features specific to Windows 10 such as printing files to PDF. Business users in particular may enjoy juggling open windows by arranging them across multiple desktops.

You don't need any great skill to make these changes, nor should they cause any harm to your system. However, as always, we recommend that you make a full backup of your data before modifying Windows 10 in any shape or form. Let's get started.

Reveal Windows 10's hidden gems

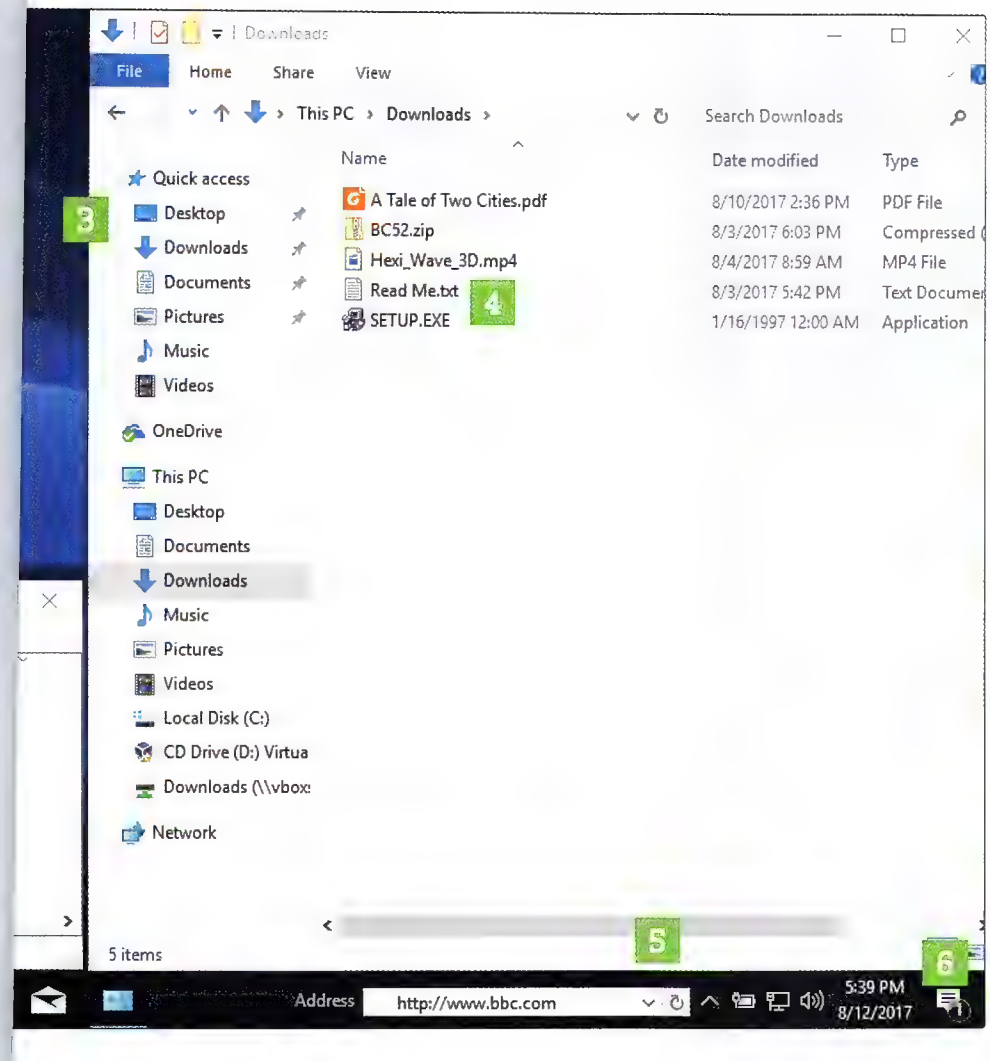
1 SHOW THE DESKTOP

This very handy button no longer displays by default in the latest version of Windows. To reactivate, click on the small bar at the very bottom-right of the screen and choose 'Show desktop' to minimise all windows as you used to do. As the name suggests, the 'Peek at desktop' option enables you to quickly glance at the desktop without minimising any windows.



2 ENABLE 'GOD MODE'

Windows contains a special Control Panel applet that gives you near omnipotent control of your system. To get started, right-click anywhere on the desktop, choose 'New folder' and enter the name: GodMode.{ED7BA470-8E54-465E-825C-99712043E01C} Press Enter. The folder icon will now change. Click this to access a huge range of configurable system settings



1 GOD MODE
This gives you instant access to system settings, such as configuring your internet connection.

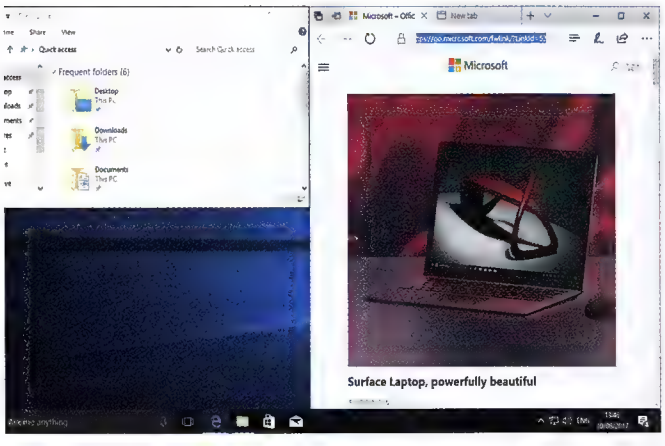
2 INTEGRATED PDF PRINTER
Windows 10 now includes a virtual printer, which you can use to convert any file to PDF.

3 SNAP ASSIST
Windows 10 can automatically resize windows to take up one half or one quarter of the screen using your mouse.

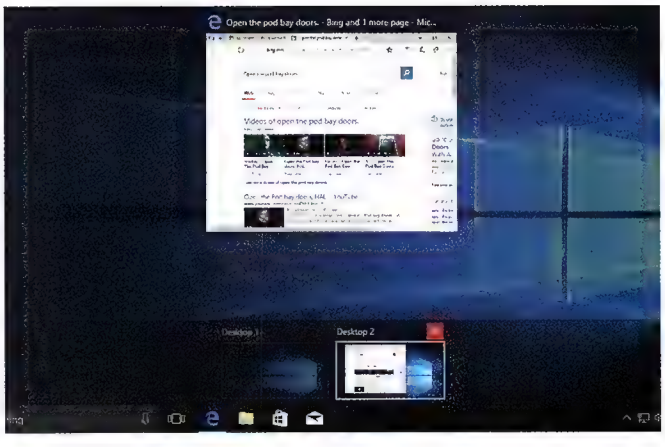
4 SHOW FILE EXTENSIONS
Use the View menu in File Explorer to display the three letter extension for each of your files.

5 QUICK LAUNCH FROM TASKBAR
Add a browser address bar to your Taskbar. This allows you to quickly view your favourite sites.

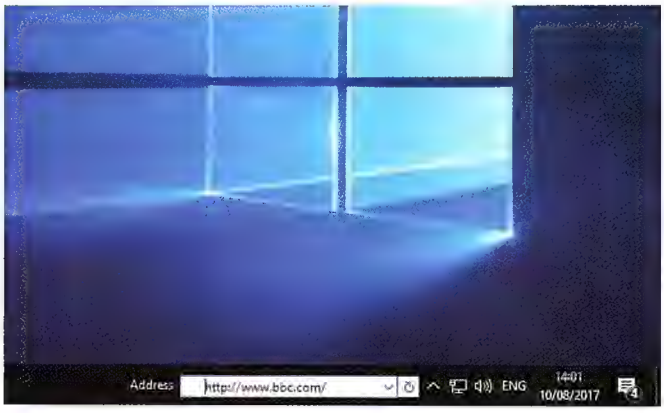
6 SHOW DESKTOP
Click to minimise windows and see the desktop. 'Peek at desktop' toggles between desktop and window view.



3 SNAP YOUR WINDOWS
Snap Assist enables you to 'snap' a window to the edge of the screen without having to manually resize it. Just click the title bar of a window and drag it to the edge of the screen. Windows 10 will display an outline of where the window will be located. Release the mouse button to snap it into place. You can also press 'Win-arrow key' on an active window to snap it into place.

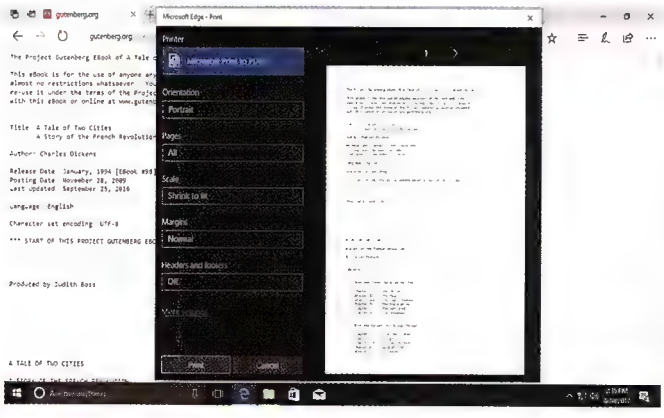


4 USE MULTIPLE DESKTOPS
You can divide your applications across several desktops. Click the small square button to the right of the Start menu and choose New Desktop. From there, you can move open windows to the new desktop using drag and drop. Right-click a particular desktop to show running windows. Click the 'X' to close a desktop, this will move windows to the next remaining desktop.



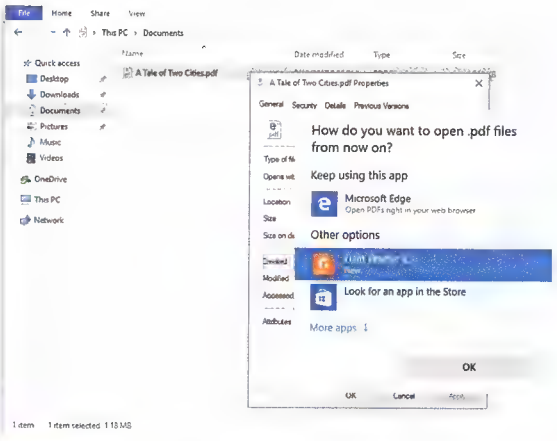
5 LAUNCH WEBSITES FROM THE TASKBAR

You can simplify the process of accessing websites or files by right-clicking the Taskbar. Choose 'Toolbar > Address' and a web address bar will appear in the Taskbar. Enter the URL of a favourite website and press Enter to launch your default web browser and go to the site. Right-click the Taskbar and choose New Toolbar to automatically open a specific folder, such as Pictures.



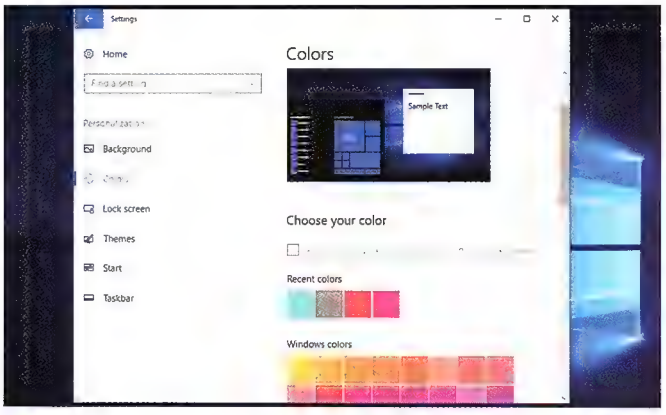
7 PRINT TO PDF

Windows 10 finally enables you to print files to PDF format. Simply open the document in question and choose 'Ctrl-P' to open the print dialog. Under Printer choose 'Microsoft Print to PDF'. You can then choose the options in the usual way, such as orientation, and click Print. A new window will open asking you to specify a name and file output location for your PDF.


How do you want to open .pdf files from now on?
Keep using this app
Microsoft Edge
Other options
Look for an app in the Store
More apps
OK

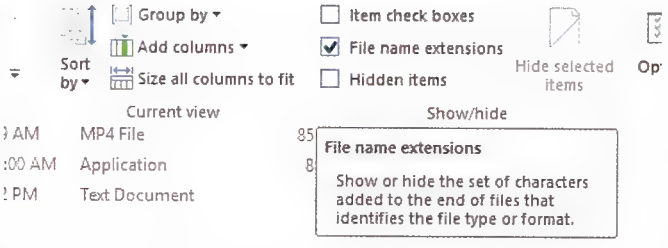
9 CHANGE PROGRAMS USED TO OPEN FILES

Most files can be opened by more than one kind of program. If you have a preferred app, right-click on a file and choose Properties. In the new window that opens, click Change. Windows will ask how you want to open this file type. Choose your favourite program, then click OK. Click Apply in the Properties window, then close it. Your default app is now set.



6 PERSONALISE YOUR DESKTOP

While many users are happy with the default look and feel of Windows, if you have activated Windows 10, you can change it. Go to 'Start > Settings > Personalisation'. From here, you can choose a new desktop background. Alternatively, click Colours to change the window colours. You can choose below to have these colours affect the Start, Taskbar and Action Centre.



8 DISPLAY HIDDEN ITEMS AND FILE EXTENSIONS

It can sometimes be tricky to know what a file is without being able to see its file extension (.pdf, for example). Change this by opening File Explorer and ticking the box marked 'File name extensions'. If you need to manipulate hidden files you can also choose to select 'Hidden items' here, although you should only do this if you've specifically been asked to do so by Microsoft.

10 ADD TILES TO THE START MENU

Love it or hate it, you can now drag Quick Launch items from your menu into the tiles in your Start menu. While this is trivial, did you know you can also right-click a tile to resize it or remove it altogether? If, for instance, you don't think you'll have any use for Groove Music, right-click and choose 'Unpin from Start'. You can right-click a tile to toggle the glitzy 'live' mode, too.

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THE BUILDER'S GUIDE TO
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PS VITA • iOS • ANDROID
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Make your way in Minecraft's most terrifying dimension
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BUILD A CASTLE
An epic manor with an evil twist
AT ALL GOOD NEWSAGENTS!
BIG RESULTS
INCREDIBLE FANTASY CREATIONS
BEAT THE CREEPER & ZAP THE ZOMBIE
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Organise your Mac workspace

Nake Drake shows how to use Magnet to simplify your desktop layout.

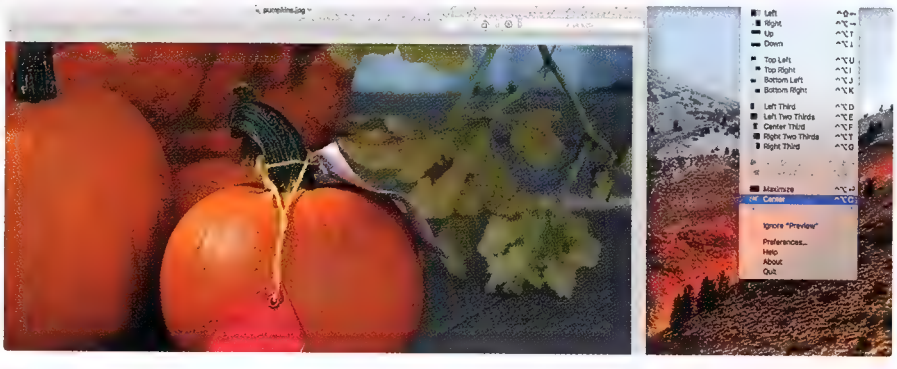
While the Mac desktop is fairly intuitive, minimising and reopening multiple windows can be a real chore, especially if you're working with multiple apps at once. Magnet is a handy window manager that's often near or at the top of the Mac App Store's paid-for apps chart. It offers a simple way to arrange windows on your desktop. At time of writing, it was selling at just $1.49.

You can use Magnet to automatically resize windows to a quarter, half or third of your desktop, and you can stack multiple apps neatly with just a swish of your mouse or by using Magnet's intuitive keyboard shortcuts.

MULTIPLE OPTIONS

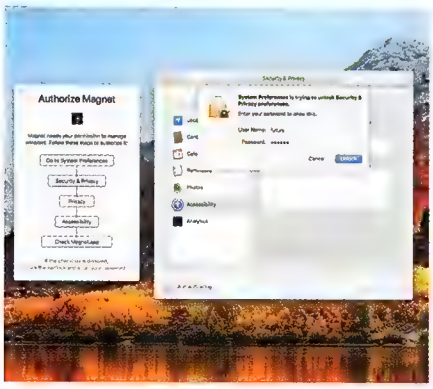
The app offers a broad range of options for 'tiling' your windows beyond the simple zoom and minimise options offered by macOS. You can drag iTunes to the bottom-right corner of your screen so that it takes up just one quarter of the desktop, allowing you to browse your playlists as you work. Why not have Safari take up the upper half of your screen, so you're free to browse the web at the same time as organise your tunes?

The latest version of Magnet (2.1) has now been optimised for High Sierra. Other changes include support for dividing your desktop into thirds (see the walkthrough) or two-thirds portions, as well as compatibility with Adobe Creative Cloud apps. And if you have multiple displays, you'll be pleased to learn that Magnet can support up to six.



How to

Set up Magnet



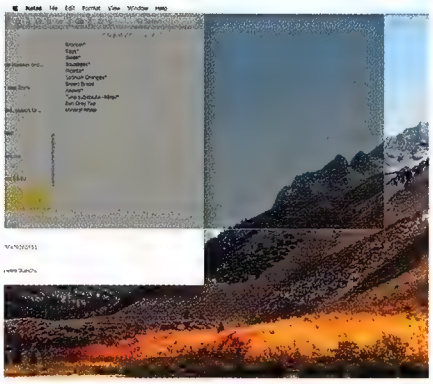
1 AUTHORISE MAGNET

With Magnet installed on your Mac, open '' > System Preferences > Security & Privacy'. Click the Privacy tab, then select Accessibility on the left. Click the padlock (bottom left), enter your admin password, then put a tick next to Magnet.

Congrats!
You have just gained a productivity boost.
Drag windows to the edges and corners to make them fullscreen, halves, quarters & thirds.
And if dragging doesn't float your boat, there is always a little icon sitting in the Menu Bar where you can access all the features and define keyboard shortcuts.
Launch Magnet at login

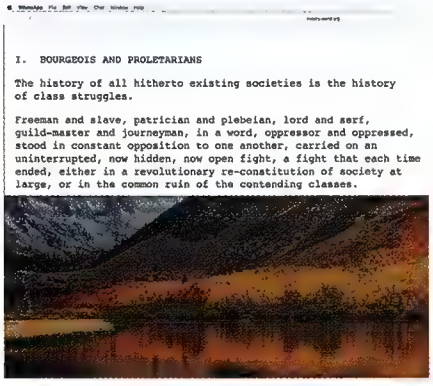
2 OPEN MAGNET AT STARTUP

Once you've authorised Magnet, the app will show a 'Congratulations' message, which details exactly how you can tile windows. When you're done.tick the box marked 'Launch Magnet at login', then close the window.



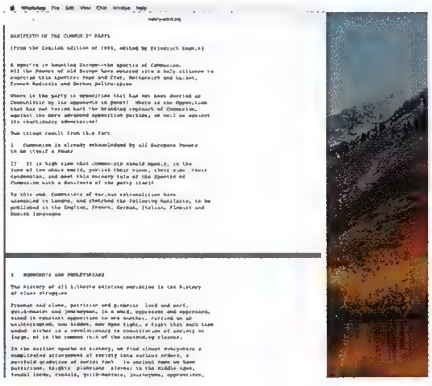
3 QUARTERING WINDOWS

Start dragging an open window from its title bar, then move the pointer to the very corner of the screen. You'll see a shaded overlay appear. Let go of the window to automatically snap and resize it to the shaded quarter (or a close fit).


I. BOURGEOIS AND PROLETARIANS
The history of all hitherto existing societies is the history of class struggles.
Freeman and slave, patrician and plebeian, lord and serf, guild-master and journeyman, in a word, oppressor and oppressed, stood in constant opposition to one another, carried on an uninterrupted, now hidden, now open fight, a fight that each time ended, either in a revolutionary re-constitution of society at large, or in the common ruin of the contending classes.

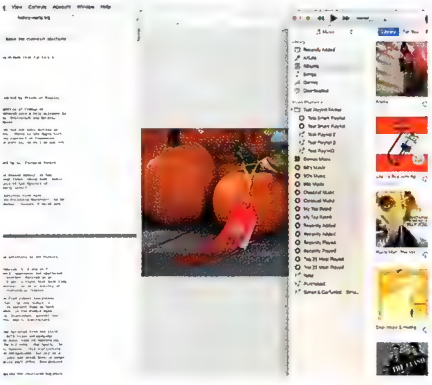
4 HORIZONTAL WINDOWS

Magnet can also arrange windows to run across the whole width of the top or bottom half of the desktop. Drag a window to the left or right edge, and then just above or below one of the corners there, then release.



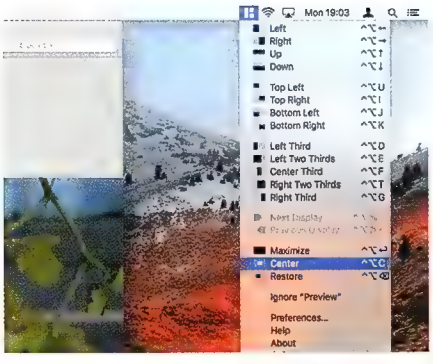
5 VERTICAL WINDOWS

Magnet can arrange a window to take up a vertical half of the desktop, which is great for working on a document while researching online. Simply drag a window to the middle of the right- or left-hand edge of the screen.



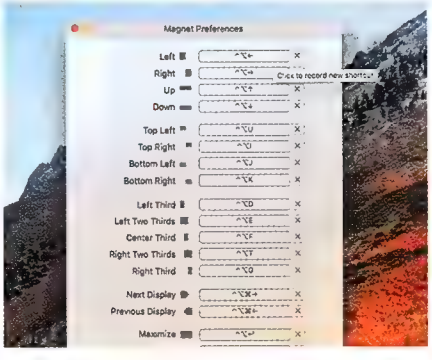
6 TILE INTO THIRDS

Windows can be arranged vertically into thirds of the desktop's width. Drag a window to and then along the screen's bottom edge; use the shaded overlays to choose a third to fill. Minimum widths imposed by apps may result in overlaps.



7 USE THE MENU

If you find it difficult to tile windows the way you want by dragging with your mouse or trackpad, click on your chosen window and then on Magnet's icon in the menu bar. From here you can select any of the tiling options outlined above.



8 MAGNET SHORTCUTS

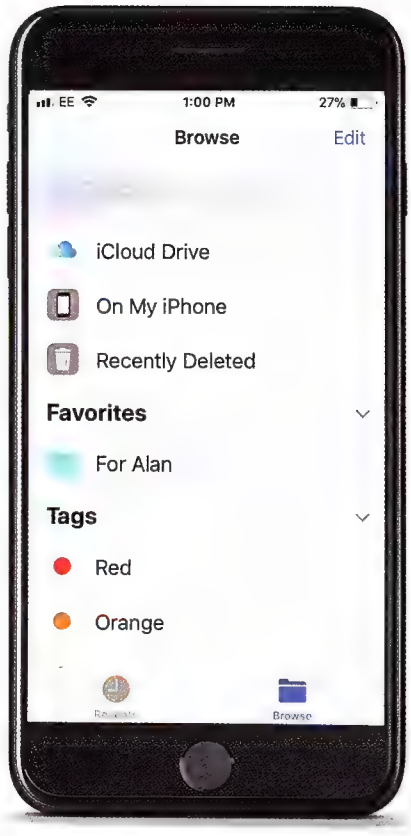
Click Magnet's icon to view keyboard shortcuts for arranging windows. These are 'Control-Shift-[another key]' by default. To record a new combo, choose Preferences from the menu, click next to a shortcut, then press your desired key combo.

9 MAGNET TWEAKS

Deselect the 'Snap windows by dragging' preference to limit invoking Magnet to its keyboard shortcuts or its menu. If you'd rather not allow Magnet to affect the app you're using, click its menu bar icon and choose Ignore [App].

Get to grips with the iOS 11 Files app

Manage files in various locations, and work remotely with other people, like Alex Summersby!



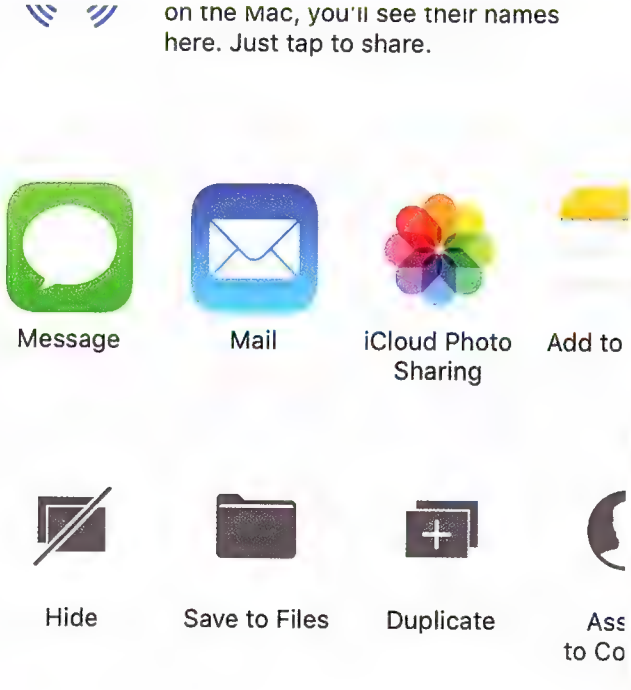
When the new Files app was announced, it sounded like an iOS equivalent of the macOS Finder, enabling you to view and organise all the files on your device. It isn't quite that. For a start, your files are not all visible in Files unless you add them to the app – you can't even see your device among the default Locations until you add at least one file to Files.

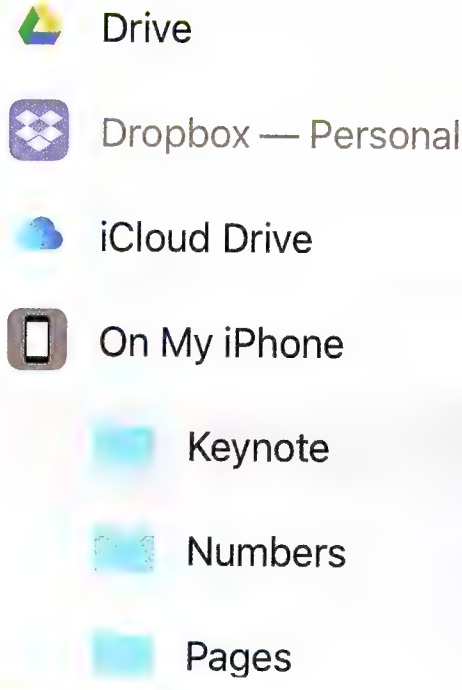
Once you start using it, though, the app does give you a convenient central point from which to view and manage your iCloud Drive, Google Drive, Dropbo, and other cloud storage locations, as well as files on your device (after you've pointed the app at them, anyway). You can move, rename and organise your files, sort them by name, date, size or custom tags you've added, and more.

The bonus is that, if you have Pages, Numbers and Keynote documents stored in iCloud Drive, the Files app also enables you to collaborate on these with other people, in real time. Here, we'll show you how, and explain some of the app's quirks and foibles. Note that some devices offer extra options – drag-and-drop on iPad, for example.

How to

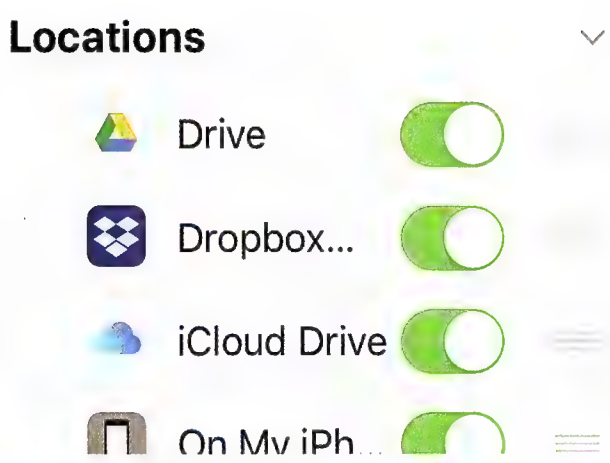
Manage and share documents using the Files app



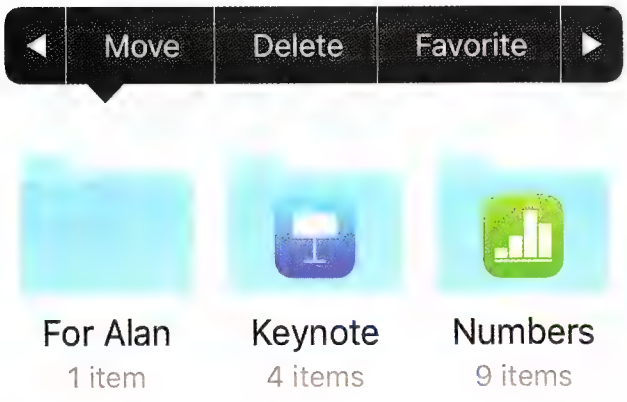


1 ENABLE 'ON MY DEVICE'
Your iOS device is not included as a Location in the Files app right away. So in any app (say Photos), pick a file, tap its Share icon and swipe to the left in the bottom row of options until you see 'Save to Files', then tap it.

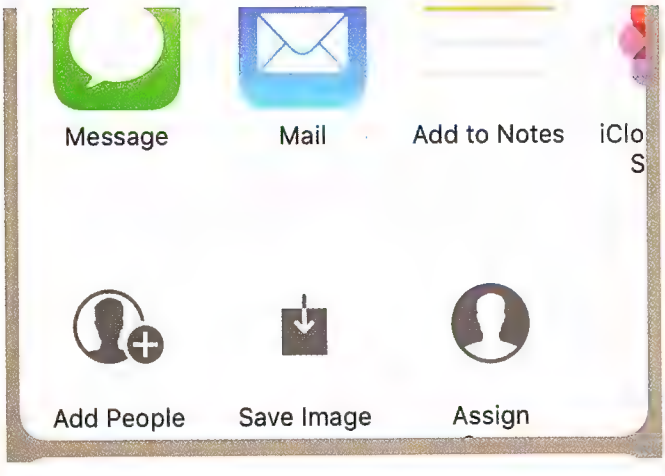
2 SAVE A FILE TO ENABLE
Next tap 'On My iPhone/iPad'. You can save only into your existing Pages, Numbers and Keynote folders, so pick any of these and tap Add. Now when you open the Files app, your device appears in the list of Locations.



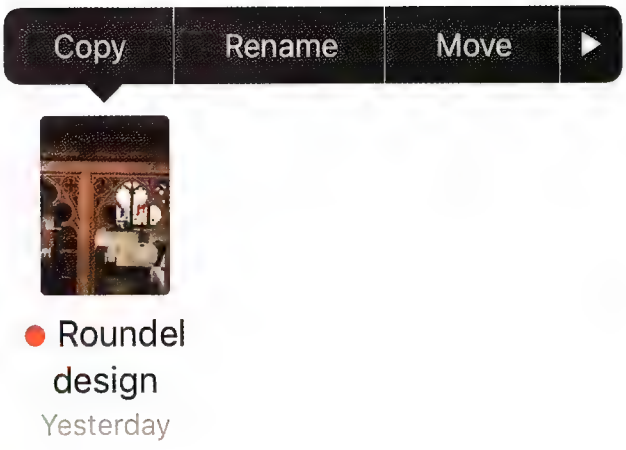
3 ADD OTHER SERVICES
Install other cloud storage apps and set them up, then open Files and tap Edit (top-right of the main Browse screen). Activate (or hide) the Locations you want, and change their order by dragging them up or down the list.



5 RECENTS AND FAVORITES
Files you've accessed in Files get added automatically to Recents, so you can access them again super-quick. For fast access to folders, add them to Favourites — tap and hold on a folder, and select Favourite in the pop-up.

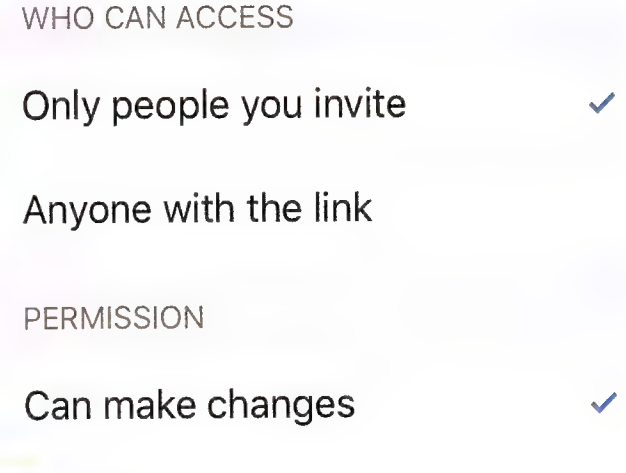


7 COLLABORATE WITH OTHERS
With a Pages, Numbers or Keynote file in your iCloud Drive, you can also invite other people to work on it with you. At the foot of the Share sheet, tap Add People, pick how to send invites, then tap Share Options below.



4 USING TAGS
To duplicate, rename, move, delete or share a file, tap and hold on it and pick the task you want in the pop-up. Select Tags to apply a tag (or several), then find files with a given tag fast by tapping the tag on the Browse screen.

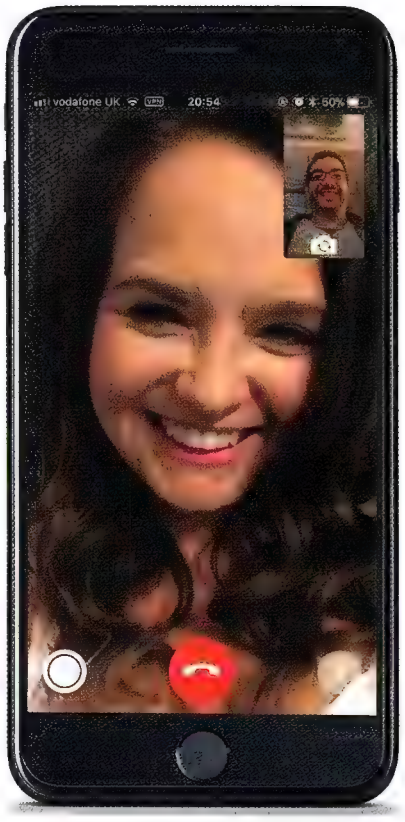
6 SHARE FILES
Tap and hold on a file and select Share, or alternatively tap Select (top-right), tap a file or multiple files to select them, then hit the Share icon at bottom-left. You can share in all the usual ways — AirDrop, Message and more.



8 SET ACCESS LEVELS
Set who can access the file and what they can do. With the settings shown, invitees who sign in can all see everyone's changes in real time, color-coded so you know who's done what. Learn more at **bit.ly/iwork_collaborate.**

Take Live Photos in FaceTime calls on iOS or Mac

Tim Hardwick reveals the privacy implications of this feature and how to protect yourself.



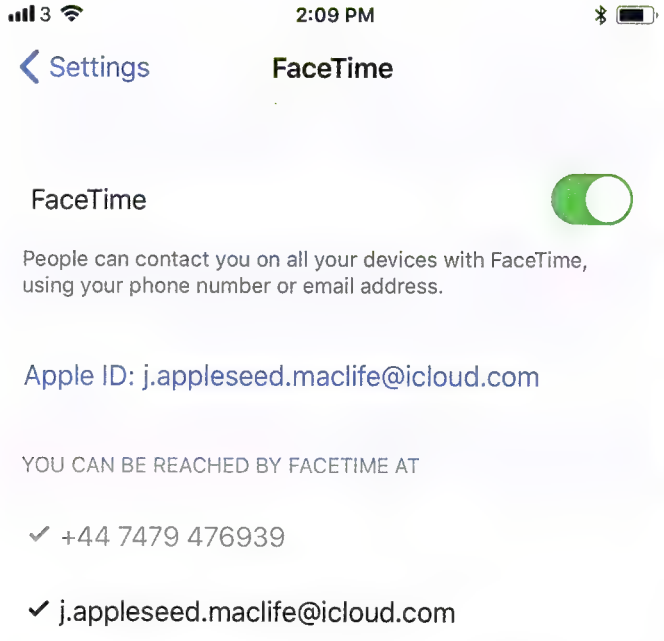
With the releaseS of iOS 11 and macOS High Sierra, Apple introduced the ability to take Live Photos during FaceTime video calls on iPhone, iPad and Mac. Live Photos record what happens 1.5 seconds before and 1.5 seconds after you take a picture, allowing the still image in the middle to come alive when you touch it.

By bringing the feature to FaceTime, Apple wants you to be able to capture special moments as they happen on screen when chatting with friends and family. That's all well and good, but what about protecting your privacy?

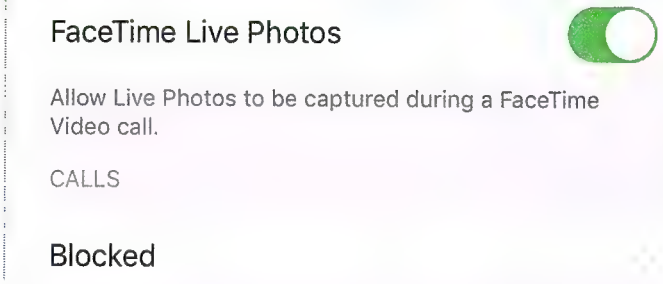
Apple gives you control over whether Live Photos can be taken during your FaceTime calls. The app also notifies you if a Live Photo is taken, so they can't be shot in secret. In addition, FaceTime strips out audio from Live Photos, so their subjects are seen but not heard. Read on to learn how to use Live Photos during FaceTime video calls on devices running iOS 11 or High Sierra.

How to

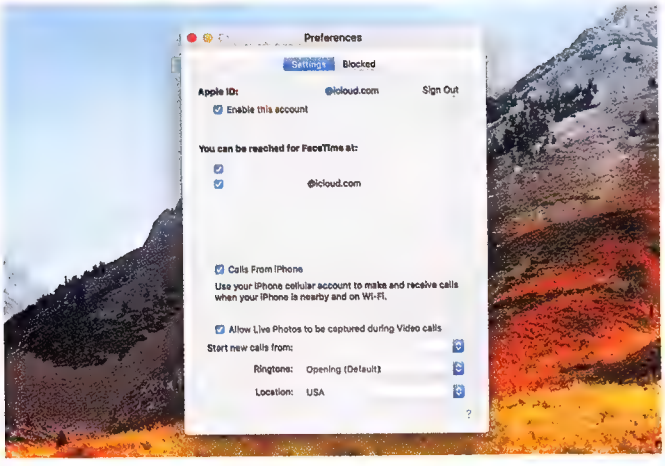
Use FaceTime's Live Photos feature



1 TURN ON FACETIME
Check that FaceTime is enabled on your device. On iOS, go to 'Settings > FaceTime' and make sure the switch at the top of the page is on. On a Mac, open the FaceTime app, and sign in with your Apple ID.

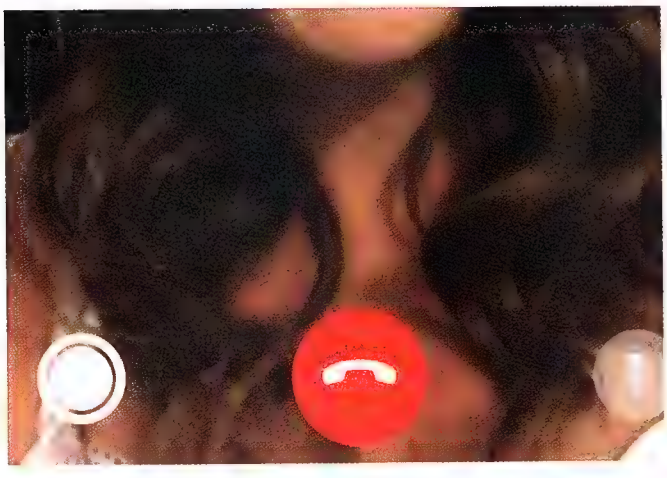


2 LIVE PHOTOS ON IOS
If you want to enable someone to take a Live Photo of you during a FaceTime video call, go to 'Settings > FaceTime' on your iPhone or iPad, then switch on the FaceTime Live Photos option near the bottom of the page.



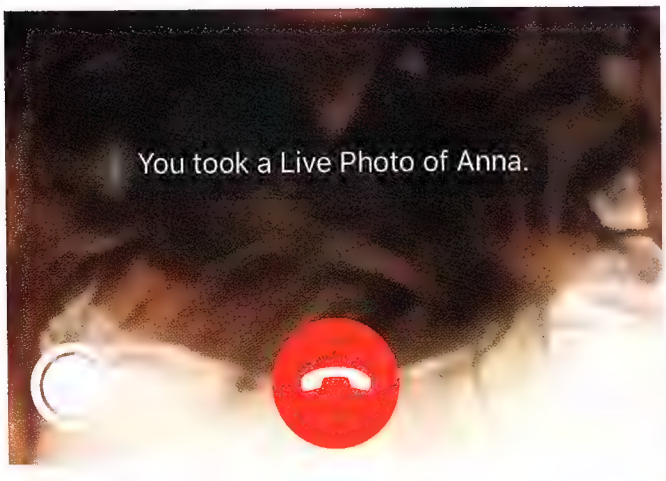
3 LIVE PHOTOS ON MAC

To do the same on a Mac, open the FaceTime app, then choose 'FaceTime > Preferences', click the Settings tab, and put a check mark in the box next to 'Allow Live Photos to be captured during Video calls'.



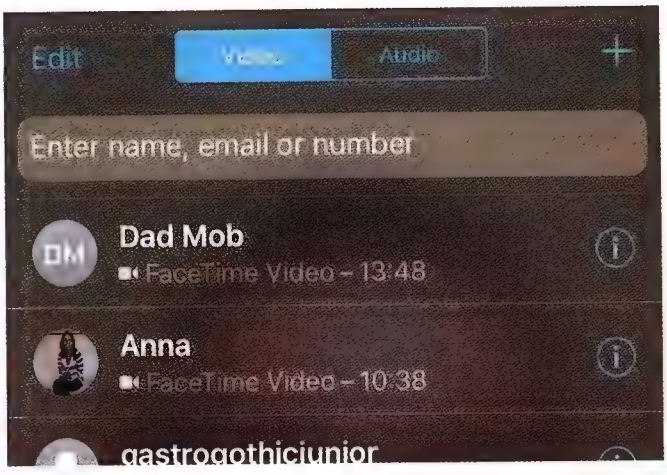
5 THE CAMERA BUTTON

Once the call connects and you can see the other person, tap the screen and look for the shutter button, to the left of the red one. If you don't see that button, the other person needs to enable Live Photos (see step 1).



7 LIVE PHOTO NOTIFICATIONS

Every time you take a Live Photo during a FaceTime video call, the other person sees a message on their screen that says 'A FaceTime Live Photo of you was taken'. This ensures Live Photos can't be taken in secret.

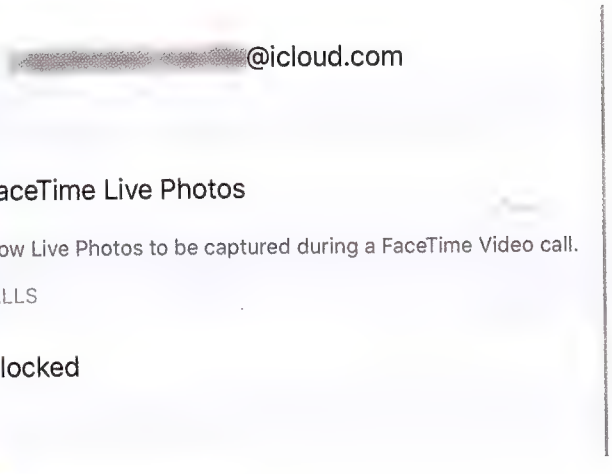


4 MAKE A FACETIME CALL

To start a FaceTime video call with someone on Mac or iOS, open the FaceTime app, go to its Video tab and either tap/click a contact in the recent calls list, or choose another contact by using the + button.

6 TAKE A LIVE PHOTO

When you're ready to take a Live Photo, tap the shutter button. The image will be automatically saved in your Photos library, on whichever device you're using. Open the Photos app and look for recently taken photos.



8 DISABLE LIVE PHOTOS

Disabling Live Photos in FaceTime is as simple as enabling them. On iOS, open 'Settings > FaceTime', and toggle the FaceTime Live Photos switch off. Find the equivalent setting on Mac in the FaceTime app's preferences.

Create an OpenVPN Linux server

Find out how to set up your own free, fast and fully functional virtual private network for on-the-road browsing. Nick Peers is your guide in the know...

Just how secure is your internet connection? The answer is often, "Not very." One of the most insecure places to surf the web or check your email is via a public Wi-Fi hotspot. After all, you don't know what security measures – if any – these shops or companies have put into place. What you need is a guaranteed form of encryption to keep your business private, and that's where a virtual private network (VPN) comes in.

VPNs are designed to add an extra layer of security to the internet and other public networks. They basically create a secure 'tunnel' inside which all your data is encrypted before being sent over the network. Their main use for home users is to provide a secure connection to the internet, even over insecure networks. Commercial VPN services offer free packages, but these are slow and limited.

A better option is to add your own to your Linux PC for free. Thanks to OpenVPN, you can set up your own server, then configure it to provide one or more devices (mobile or computer) with a secure on-demand VPN network whenever it's required. Without further ado, then, let's get started.

WHAT YOU'LL NEED

The following tutorial works with your basic Ubuntu 16.04 install – the only real requirement is that your PC is turned on and connected to the internet at home whenever you want to employ your VPN's services abroad.

First, let's install OpenVPN Server. Although it's part of the official Ubuntu repositories, you can't install it through Software Centre, so open a Terminal window and type this:

```
$ sudo apt-get update
$ sudo apt-get install openvpn easy-rsa
```

This installs two packages – the latter (easy-rsa) sets up and then manages the certificates that are required to encrypt your network traffic. The easy-rsa package enables you to use OpenVPN in a PKI (public key infrastructure), which consist of public and private keys for each server and client, with the public keys being used to identify trusted clients and servers to each other. These public keys are signed using certificates to verify their identity, and your server needs to be configured as a certificate authority (CA) to create, distribute and manage these certificates.

Your first job then is to set up your CA and build the server's private and public keys – check out the step-by-step guide for details. Once that process is complete, it's a good idea to 'harden' your VPN's security further. This is done with the following Terminal commands:

```
$ cd ~/openvpn-ca
$ ./build-dh
$ openvpn --genkey --secret keys/ta.key
```

CONFIGURE OPENVPN SERVER

Now it's time configure your OpenVPN server and getting it up and running. First, you need to copy the encryption keys and other files you've just created to the /etc/openvpn directory, again using the Terminal:

```
$ cd ~/openvpn-ca/keys
$ sudo cp ca.crt ca.key MyVPN.crt MyVPN.key ta.key dh2048.pem /etc/openvpn
```

Replace MyVPN.crt and MyVPN.key with the value you allocated to KEY_NAME in the walkthrough on page 88. Next, you need to generate your OpenVPN configuration file:

```
$ cd /usr/share/doc/openvpn/examples/sample-config-files
$ sudo cp server.conf.gz /etc/openvpn
$ sudo gzip -d /etc/openvpn/server.conf.gz
```

Now follow the second step-by-step guide on page 89 to configure your server for basic usage. Once that's complete, you need to perform one critical step to enable your clients

The make_config.sh script

Open a Terminal and type the following command to create an empty file:

```
$ nano ~/openvpn-ca/client-configs/make_config.sh
```

Now enter the following lines:

```
#!/bin/bash
# First argument: Client identifier
KEY_DIR=~/openvpn-ca/keys

OUTPUT_DIR=~/openvpn-ca/client-configs/files
BASE_CONFIG=~/openvpn-ca/client-configs/client.conf

cat ${BASE_CONFIG} \
    <(echo -e '<ca>') \
    ${KEY_DIR}/ca.crt \
    <(echo -e '</ca>\n<cert>') \
    ${KEY_DIR}/${1}.crt \
    <(echo -e '</cert>\n<key>') \
    ${KEY_DIR}/${1}.key \
    <(echo -e '</key>\n<tls-auth>') \
    ${KEY_DIR}/ta.key \
    <(echo -e '</tls-auth>') \
    > ${OUTPUT_DIR}/${1}.ovpn
```

Once created, save and close the file before typing the following command to make it an executable:

```
$ chmod 700 ~/openvpn-ca/client-configs/make_config.sh
```

Set up your client

You can access your OpenVPN server through a variety of platforms — there's an official client for Windows, Android and iOS (visit **www.openvpn.net** for details), while MacOS users can use Tunnelblick (**www.tunnelblick.net**). Transferring the .opvn configuration file varies from device to device: you can simply copy the file to **C:\Program Files\OpenVPN\config** in Windows, for example, or double-click it to import it into Tunnelblick on MacOS.

If you're running an Ubuntu client, you can install some additional packages and manage your connection through the GUI-friendly Network Manager. Open a Terminal and type the following:

```
$ sudo apt-get update
$ sudo apt-get install network-manager-openvpn-gnome
```

Once installed, open the Network Manager from the menu bar and select Edit Connections, then click Add. Choose 'Import a saved VPN configuration...' from the drop-down menu and click Create. Select your .ovpn file and click Open, then verify the settings are correct across the four tabs (click 'Advanced > TLS Authentication' tab to confirm it's also recognised the TLS key). Give your connection a more suitable name — say, the name you assigned your VPN under KEY_NAME — and then click Save.

Once done, connect through the Network Manager's VPN submenu — you should see a lock appear over the menu bar's icon, indicating that the connection has successfully been made. The final step is to open your browser to verify that the connection works.

to actually access the internet through your VPN. First, enter the following command:

```
$ ip route | grep default
```

Make a note of the interface listed next to 'dev' — on our machine this is enp0s3. Now enter the following command, substituting enp0s3 with the interface listed on your PC if applicable:

```
$ sudo iptables -t nat -A POSTROUTING -s 10.8.0.0/24 -o enp0s3 -j MASQUERADE
```

START AND TEST

It's time to get things up and running. Type the following Terminal command, which launches OpenVPN using the server.conf file you've configured:

```
$ sudo systemctl start openvpn@server
```

Now check the server is running correctly:

```
$ sudo systemctl status openvpn@server
```

You should see a list of messages, including the all-important active (running) message, along with Initialization sequence completed at the bottom — press 'Ctrl-C' to interrupt the status check. Next, check the OpenVPN interface is available:

```
$ ip addr show tun0
```

If it shows a configured interface ending with `valid_lft forever preferred_lft forever`, then things should be working correctly. You can now configure OpenVPN to launch automatically at startup with the following line:

```
$ sudo systemctl enable openvpn@server
```

PLEASING KEY CLIENTS

The simplest way to configure your client is through the use of specially made .ovpn files, inside which the required key files are embedded along with the settings needed to connect. These are created on your server, and here's what you need to do.

First, create a directory structure inside which your client configuration files are stored, then lock down the directory permissions and create a base config file to work from:

```
$ mkdir -p ~/openvpn-ca/client-configs/files
$ chmod 700 ~/openvpn-ca/client-configs/files
```

Now open the Nautilus file manager, click the Computer link on the left, and browse to /usr/share/doc/openvpn/examples/sample-config-files/. Copy the client.conf file from here to ~/openvpn-ca/client-configs. Double-click the copied file to edit it in gedit. First, locate the line marked `remote my-server-1 1194` and change this to point towards your server's public IP address or dynamic DNS name (see the Quick Tip box opposite) — for example: `remote 1.2.3.4 1194` or `remote dynamic.ddns.net 1194`.

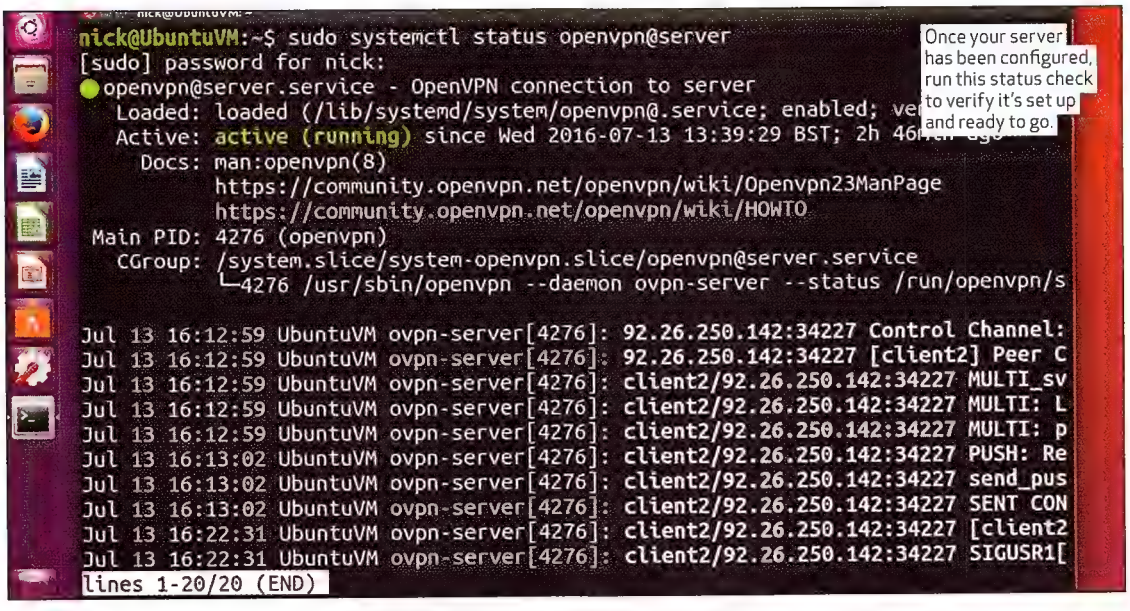
Next, uncomment both `;user nobody` and `;group nogroup` before commenting out the lines `ca ca.crt`, `cert client.crt` and `key client.key` because they're added by the batch file. Last, but not least, add the following line beneath:

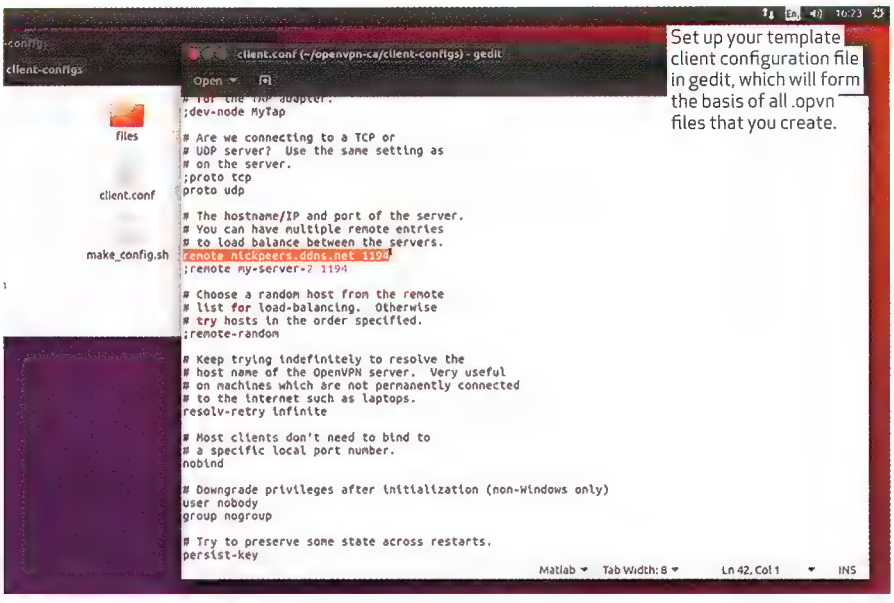
```
;tls-auth ta.key 1
```

(which should remain commented out):

```
key-direction 1
```

Save and exit, then follow the instructions in the box to create the make_config.sh file, which you'll use to


nick@UbuntuVM:~$ sudo systemctl status openvpn@server
[sudo] password for nick:
openvpn@server.service - OpenVPN connection to server
Loaded: loaded (/lib/systemd/system/openvpn@.service; enabled; ve
Active: active (running) since Wed 2016-07-13 13:39:29 BST; 2h 46
Docs: man:openvpn(8)
https://community.openvpn.net/openvpn/wiki/Openvpn23ManPage
https://community.openvpn.net/openvpn/wiki/HOWTO
Main PID: 4276 (openvpn)
CGroup: /system.slice/system-openvpn.slice/openvpn@server.service
└4276 /usr/sbin/openvpn --daemon ovpn-server --status /run/openvpn/s
Jul 13 16:12:59 UbuntuVM ovpn-server[4276]: 92.26.250.142:34227 Control Channel:
Jul 13 16:12:59 UbuntuVM ovpn-server[4276]: 92.26.250.142:34227 [client2] Peer C
Jul 13 16:12:59 UbuntuVM ovpn-server[4276]: client2/92.26.250.142:34227 MULTI_sv
Jul 13 16:12:59 UbuntuVM ovpn-server[4276]: client2/92.26.250.142:34227 MULTI: L
Jul 13 16:12:59 UbuntuVM ovpn-server[4276]: client2/92.26.250.142:34227 MULTI: p
Jul 13 16:13:02 UbuntuVM ovpn-server[4276]: client2/92.26.250.142:34227 PUSH: Re
Jul 13 16:13:02 UbuntuVM ovpn-server[4276]: client2/92.26.250.142:34227 send_pus
Jul 13 16:13:02 UbuntuVM ovpn-server[4276]: client2/92.26.250.142:34227 SENT CON
Jul 13 16:22:31 UbuntuVM ovpn-server[4276]: client2/92.26.250.142:34227 [client2
Jul 13 16:22:31 UbuntuVM ovpn-server[4276]: client2/92.26.250.142:34227 SIGUSR1[
lines 1-20/20 (END)
Once your server has been configured, run this status check to verify it's set up and ready to go.


client.conf (~/openvpn-ca/client-configs) - gedit
Open
client-configs
files
client.conf
make_config.sh
;dev-node MyTap
Are we connecting to a TCP or
UDP server? Use the same setting as
on the server.
;proto tcp
proto udp
The hostname/IP and port of the server.
You can have multiple remote entries
to load balance between the servers.
remote nickpeers.ddns.net 1194
;remote my-server-2 1194
Choose a random host from the remote
list for load-balancing. Otherwise
try hosts in the order specified.
;remote-random
Keep trying indefinitely to resolve the
host name of the OpenVPN server. Very useful
on machines which are not permanently connected
to the internet such as laptops.
resolv-retry infinite
Most clients don't need to bind to
a specific local port number.
nobind
Downgrade privileges after initialization (non-Windows only)
user nobody
group nogroup
Try to preserve some state across restarts.
persist-key
Matlab
Tab Width: 8
Ln 42, Col 1
INS

Set up your template client configuration file in gedit, which will form the basis of all .opvn files that you create.

generate the client configuration files whenever they're needed for each client.

GENERATE A CLIENT CONFIG FILE

You've now got all the tools you need to create your client configuration files. Here's the process you need to follow in order to build them. First, you need to generate a certificate and key for your client using the following two commands:

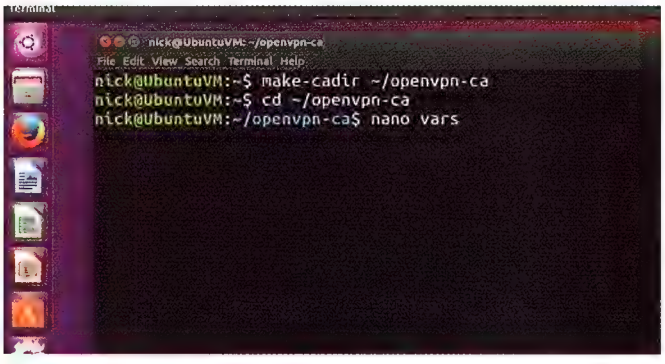
```
$ cd ~/openvpn-ca && source vars
```

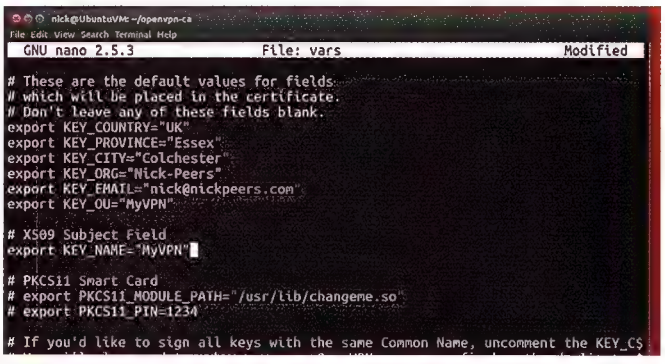
This time, ignore the note – we don't want to clean anything – then type:

```
$ ./build-key client1
```

You'll need a unique name for each client certificate you generate – so for subsequent certificates, you'd use client2, client3 and so on. Again, you'll be taken through a similar process to

Accept my (Certificate) Authority!




nick@UbuntuVM: ~/openvpn-ca
File Edit View Search Terminal Help
GNU nano 2.5.3 File: vars Modified
These are the default values for fields
which will be placed in the certificate.
Don't leave any of these fields blank.
export KEY_COUNTRY="UK"
export KEY_PROVINCE="Essex"
export KEY_CITY="Colchester"
export KEY_ORG="Nick-Peers"
export KEY_EMAIL="nick@nickpeers.com"
export KEY_OU="MyVPN"
X509 Subject Field
export KEY_NAME="MyVPN"
PKCS11 Smart Card
export PKCS11_MODULE_PATH="/usr/lib/changeme.so"
export PKCS11_PIN=1234
If you'd like to sign all keys with the same Common Name, uncomment the KEY_CS

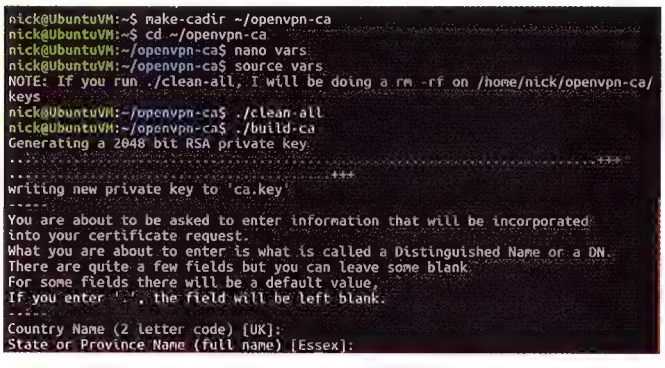
1 CERTIFICATE AUTHORITY

First, you need to copy the easy-rsa template directory to your home directory so your custom certificates aren't overwritten when the package is updated. Open the Terminal and type the following:

```
$ make-cadir ~/openvpn-ca
$ cd ~/openvpn-ca
$ nano vars
```

2 EDIT VARS FILE

Scroll down to the group of lines beginning `export KEY_COUNTRY` and fill them in with your own personal information – see the screenshot for an example. Note `KEY_PROVINCE` should be filled with the county, such as 'Essex' or 'Merseyside'. Put your name or organisation in `KEY_ORG`, and fill `KEY_OU` and `KEY_NAME` with whatever you like, such as `MyVPN` . Save the file (Ctrl+O) and exit


nick@UbuntuVM:~$ make-cadir ~/openvpn-ca
nick@UbuntuVM:~$ cd ~/openvpn-ca
nick@UbuntuVM:~/openvpn-ca$ nano vars
nick@UbuntuVM:~/openvpn-ca$ source vars
NOTE: If you run ./clean-all, I will be doing a rm -rf on /home/nick/openvpn-ca/keys
nick@UbuntuVM:~/openvpn-ca$ ./clean-all
nick@UbuntuVM:~/openvpn-ca$ ./build-ca
Generating a 2048 bit RSA private key
writing new private key to 'ca.key'
You are about to be asked to enter information that will be incorporated into your certificate request.
What you are about to enter is what is called a Distinguished Name or a DN.
There are quite a few fields but you can leave some blank
For some fields there will be a default value,
If you enter '.', the field will be left blank.
Country Name (2 letter code) [UK]:
State or Province Name (full name) [Essex]:

nick@UbuntuVM: ~/openvpn-ca
File Edit View Search Terminal Help
Please enter the following 'extra' attributes
to be sent with your certificate request
A challenge password []:
An optional company name []:
Using configuration from /home/nick/openvpn-ca/openssl-1.0.0.cnf
Check that the request matches the signature
Signature ok
The Subject's Distinguished Name is as follows
countryName :PRINTABLE:'UK'
stateOrProvinceName :PRINTABLE:'Essex'
localityName :PRINTABLE:'Colchester'
organizationName :PRINTABLE:'Nick-Peers'
organizationalUnitName:PRINTABLE:'MyVPN'
commonName :PRINTABLE:'MyVPN'
name :PRINTABLE:'MyVPN'
emailAddress :IA5STRING:'nick@nickpeers.com'
Certificate is to be certified until Jul 10 11:05:18 2026 GMT (3650 days)
Sign the certificate? [y/n]:y

3 BUILD A CERTIFICATE AUTHORITY

At the Terminal, verify you're still in the openvpn-ca directory, then type `source vars` and hit Enter. You should see a note appear (see screenshot). Now type `./clean-all` and hit Enter, followed by `./build-ca` . After pressing Enter, you'll be taken through the root certificate authority key and certificate. Just hit Enter when prompted to confirm each edit you made in the previous step.

4 GENERATE THE SERVER'S KEYS

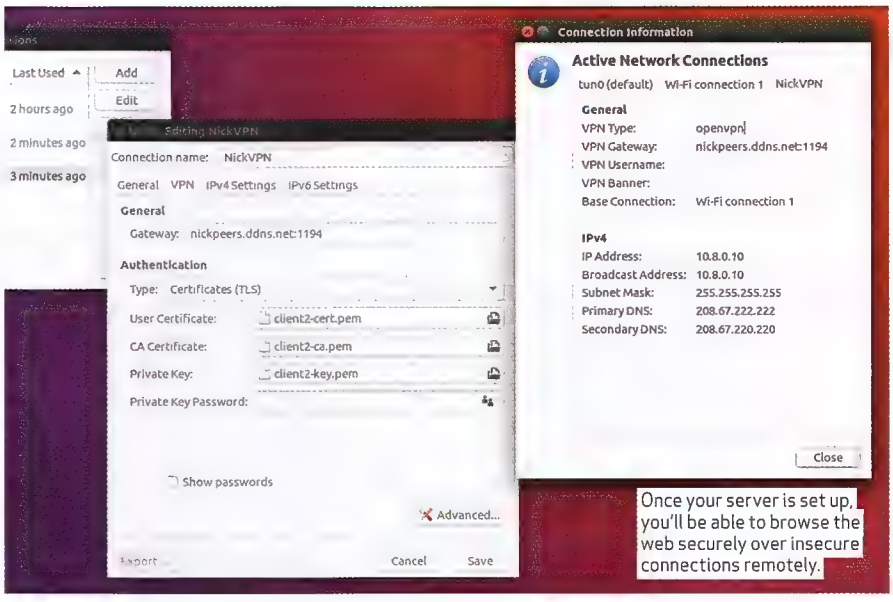
Type `./build-key-server MyVPN` and hit Enter, replacing 'MyVPN' with the value you entered for `KEY_NAME` in Step 2. Press Enter to accept the default choices as before. When prompted to create a challenge password, press Enter to leave it blank, and press Enter again when prompted for an optional company name, Complete the process by pressing Y to the last two prompts.

that when you ran the build-server-key command, and the answers are exactly the same – no challenge password, and accepting the default choices.

Once generated, it's time to build the configuration file:

```
$ cd client-configs
$ ./make_config.sh client1
```

You'll find a file marked client1.ovpn inside the client-configs/files sub-folder. This now needs to be securely transferred to your client – the box reveals the different options available to you, and how to configure a VPN connection to your server from another Linux PC. Congratulations, you've just made your internet connection a more secure one!



Once your server is set up, you'll be able to browse the web securely over insecure connections remotely.

Configure your server

```
GNU nano 2.5.3          File: server.conf          Modified

# and private keys.  Remember to use
# a unique Common Name for the server
# and each of the client certificates.
#
# Any X509 key management system can be used.
# OpenVPN can also use a PKCS #12 formatted key file
# (see "pkcs12" directive in man page)
ca ca.crt
cert MyVPN.crt
key MyVPN.key # This file should be kept secret

# Diffie hellman parameters.
# Generate your own with:
#   openssl dhparam -out dh2048.pem 2048
dh dh2048.pem

# Network topology
# Should be subnet (addressing via IP)
# unless Windows clients v2.0.9 and lower have to
```

1 DEFINE SERVER KEYS

Open the configuration file you've just created using `sudo nano /etc/openvpn/server.conf` at the Terminal. We're going to focus on the bare minimum settings required to get your server up and running. Start by scrolling down to the '# SSL/TLS root certificate...' section and changing `cert server.crt` and `key server.key` lines to point to the files you created in step four of the previous walkthrough.

```
nick@UbuntuVM: /etc/openvpn
File Edit View Search Terminal Help
GNU nano 2.5.3          File: server.conf

# to help block DoS attacks and UDP port flooding.
#
# Generate with:
#   openvpn --genkey --secret ta.key
#
# The server and each client must have
# a copy of this key.
# The second parameter should be '0'
# on the server and '1' on the clients.
tls-auth ta.key 0 # This file is secret
key-direction 0

# Select a cryptographic cipher.
```

2 IMPLEMENT EXTRA ENCRYPTION

Press 'Ctrl-W', type `tls-auth` and you'll be taken to a line marked `;tls-auth ta.key 0`. Remove the `;` from the beginning of this line (a process known as uncommenting) to enable it. Now add the following line underneath it as shown in the screenshot above: `key-direction 0`. This ensures that the extra TLS authentication you set up earlier is enabled for OpenVPN.

```
# all IP traffic such as web browsing and
# and DNS lookups to go through the VPN
# (The OpenVPN server machine may need to NAT
# or bridge the TUN/TAP interface to the internet
# in order for this to work properly).
push "redirect-gateway def1 bypass-dhcp"

# Certain Windows-specific network settings
# can be pushed to clients, such as DNS
# or WINS server addresses.  CAVEAT:
# http://openvpn.net/faq.html#dhcpcaveats
# The addresses below refer to the public
# DNS servers provided by opendns.com.
push "dhcp-option DNS 208.67.222.222"
push "dhcp-option DNS 208.67.220.220"
                    [ Search Wrapped ]
```

3 CONFIGURE WEB DIRECTION

These next tweaks will instruct all connected clients to route their web traffic through the VPN. Press 'Ctrl-W' to locate `redirect-gateway` and uncomment the line it's on – namely 'push...' Also uncomment the next two instances of 'push' referring to DNS servers as shown in the screenshot above. Finally, search for 'nobody' and uncomment the 'user nobody' and 'group nogroup' lines. Save and exit.

```
nick@UbuntuVM: /etc/openvpn
File Edit View Search Terminal Help
GNU nano 2.5.3          File: /etc/sysctl.conf          Modified

#########################################################3
Functions previously found in netbase


Uncomment the next two lines to enable Spoof protection (reverse-path filter)
Turn on Source Address Verification in all interfaces to
prevent some spoofing attacks
net.ipv4.conf.default.rp_filter=1
net.ipv4.conf.all.rp_filter=1

Uncomment the next line to enable TCP/IP SYN cookies
See http://lwn.net/Articles/277146/
Note: This may impact IPv6 TCP sessions too
net.ipv4.tcp_syncookies=1

Uncomment the next line to enable packet forwarding for IPv4
et.ipv4.ip_forward=1
```

4 ENABLE IP FORWARDING

Type `sudo nano /etc/sysctl.conf` and uncomment out the following line by removing the preceding # symbol from it: `#net.ipv4.ip_forward=1`. Save and exit, then type the following command to reload sysctl: `sudo sysctl -p`. You should see `net.ipv4 ip_forward =1` appear, indicating the setting has been correctly applied. That's it!

Return to the glory days

We're not even sure what happened to this rig, but with lots of TLC, Zak Storey injects it with a new zest for life.

THE CONCEPT

Upon opening the chassis and dodging the cloud of dust containing every respiratory disease known to man, we bore witness to the true horror of an unloved PC. The panels, once standing proud, pristinely showcasing the hardware within, sheared off the side of the case with an eerie screech, the filth and grime breaking free as the thumbscrews gave up their long vigil protecting the beating heart of the machine inside. Fan blades littered the floor – the slow ravages of hard time in this technological gulag had stripped the polypropylene scythes from their housings. As once free-moving bearings glinted in the ephemeral twilight of the photography studio, we began to realise that this was unlike any horror we had witnessed before. The executive editor's PC lay in ruins. Working hard, day in, day out, for years on end, to produce one of the world's best-selling PC magazines [*And in all that time, it's had but one wish... to be a real boy.* – Ed], it was a rig that had suffered much.

Yet all was not lost – this was not the end for the BitFenix Shinobi. Its pseudo Japanese-German heritage would live on, we would make sure of that. The challenge that lay before us was undeniably daunting.

Even though it was only five years of age, this machine had been through a lot. And with its vast arsenal of computational prowess within, once the pride of its generation, now falling defunct in its dotage, it stood in stark contrast to the other mammoths beavering away in the *APC* office. The task at hand was simple: sanitise it, gut it and install the latest available hardware, bringing the lumbering beast of burden back to glory, to bear its might upon the transistor-fused world once more.

CLEANING THE UNCLEAN

Right! Now we've got that out of the way, let's talk about what we're replacing in our executive editor's machine. This isn't a simple new build, but more of a core upgrade to some legendary componentry. And while we're at it, an attempt to retain that old, beaten chassis – because, well, we're sadists.

This machine once hosted an Intel Core i7-3820 quad-core 32nm processor, 16GB of quad-channel DDR3, an ASUS X9 X79 Pro motherboard, a Sapphire Radeon R9 390 GPU, a half-working Thermaltake 240mm AIO CPU cooler, a 250GB Samsung 840 Evo and a 3TB WD Red hard drive.

To keep things fairly simple, and encourage good system maintenance, we've opted for a few more industrially centred components to power the magnificent Shinobi and give it a bit more processing grunt. It may be powering a 1,920 x 1,200 screen (yep, one of those), but that's no reason to deny it the juice to deal with more demanding titles destined to come out in the future.

We've gone for an Intel Core i7-7700K running at stock, a dual-channel kit of 16GB DDR4, a GTX 1080 card and a Gigabyte Z270X Gaming K5 motherboard. But the more important changes come in the form of cooling. This time, instead of a liquid cooler, we've gone for one of Noctua's NH-C14S towers, paired with two Noctua NF-A14 IP67-rated, dustproof, industrial-grade 140mm fans. We've also included four 120mm EK Vardar Evos: one at the front, in the 5.25-inch drive bay, as an intake; two in the roof, exhausting; and one in the rear, also acting as an exhaust. We've also kept the massive 230mm BitFenix Spectre in the front, because it's still too good an offer to pass up.

PARTS LIST

PART		STREET PRICE
CPU	INTEL CORE I7-7700K	$448
MOTHERBOARD	GIGABYTE Z270X GAMING K5 ATX	$249
MEMORY	16GB (2x 8GB) KINGSTON HYPERX FURY 2666	$269
GPU	NVIDIA GEFORCE GTX 1080	$769
EXHAUST FANS	4x EK VARDAR EVO 120ER BLACK 120mm	$88
CPU COOLER	NOCTUA NH-C14S	$129
CPU FANS	2x NOCTUA NF-A14 IPPC 2000 140mm	$90
TINNED AIR	COMPRESSED AIR CAN	$10
ISOPROPYL ALCOHOL	ISOPROPYL ALCOHOL 99%	$15
TOTAL		$2,067

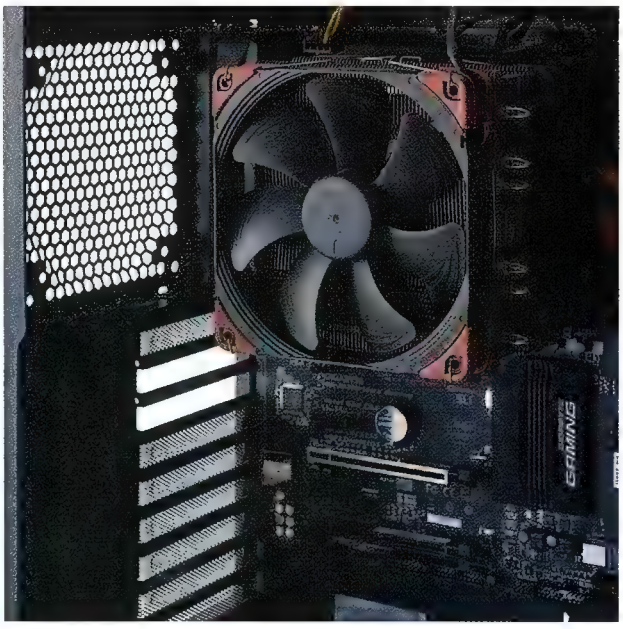
"It's pseudo Japanese-German heritage would live on, we would make sure of that. The challenge that lay before us was undeniably daunting."

1 SYSTEM MAINTENANCE

It's staggering that this liquid cooler worked as long as it did, diligently cooling the Core i7-3820 for almost five years. However, it does illustrate how imperative it is to give your rig a good clean once in a while. Dust, grime and condensation are major killers for hardware like this, and keeping your CPU cool should be one of your top priorities. We're not saying go crazy on the cleaning, but every three to six months, take your rig outside, and take a can of compressed air or even a foot pump to it, to get rid of excess dust inside the chassis. In fact, this is why we recommend windowed cases, so you can avoid the "out of sight, out of mind" philosophy.

2 STRIP DOWN

Upgrading a core system is much like building a new rig. In this case, we started by taking a can of compressed air and attempting to blow out as much of the dust as we could. Then we removed as many panels as possible, before doing the same again, and began to remove the cooling after that. This gives you the opportunity to grab a microfiber cloth and clean up any fans going back in, along with the areas on which they were mounted. We replaced a lot of the fans, so it was less of an issue, but if you're reusing them, it's not a bad idea to clean off the blades in particular, before installing them back into the chassis.



3 OUT WITH THE OLD

...and in with the new. Now we're talking. Next up, you're going to want to unplug everything from everywhere. You can leave the PSU installed in the chassis, especially in older cases. Then it's a case of removing the old motherboard and installing a new one. It's often easier to install the processor outside of the chassis first. Fortunately, thanks to the Shinobi's massive CPU cut-out, installing the backplate for the Noctua can be done after the motherboard is installed into the chassis. It's also imperative (with this cooler) that you install the memory now, too, because the cooler will cover all the slots.

4 COOLER MANAGEMENT

Swapping out fans on these kind of coolers isn't ever going to be a picnic, especially given the nature of the clips that secure the fans in place. Because this is essentially a second-hand tower cooler, the clips aren't quite as rigid now as they should be.
To counter this problem, we used a single cable tie between the top clip on the top fans and the top clip on the bottom fan, to secure them on place. Additionally, to generally tidy up the cables, we've wrapped them into small loops, to reduce mess. Because these fans are technically designed for radiators and case fans, the cables are fairly long, and so require a fair bit of inventive management to ensure they don't get caught on anything.

5 CABLES GALORE

We've got to give credit to BitFenix — the Shinobi XL is nothing if not well equipped. With four USB 3.0 ports and a powered USB port on the front of the chassis, finding places to route all of that front I/O was challenging. Fortunately, the Z270X Gaming K5 comes packing two USB 3.0 headers just south of the 24-pin. Impressively, we managed to route those two cables, plus the 24-pin, and the single 8-pin PCIe power through a single rubber grommet — and, to be honest, it still looks fairly tidy, too.

6 FINISHING UP

And there you go: one updated, cleaned-out system. We took some isopropyl alcohol to the soft-touch finish in an attempt to try to remove some of the grime and damage from the chassis, but there's only so much you can do with a case this old, unfortunately. And don't worry about that old quad-core Extreme Edition chip — it will be going off to work in a new home in our IT department, happily sauntering on toward retirement.

1 We ended up using a three-way PWM splitter to power the two fans in the roof and the front of the case, because the mobo didn't have enough headers.

2 The Shinobi still had an archaic AC97 audio cable attached to the HD audio cable — take a pair of scissors and cut it off to reduce clutter, and you should be fine.

3 This 1,500W PSU is a bit OTT (about seven times too much) for this build, but it would be an unnecessary expense to change it over, and it still works a treat.

4 We moved both the hard drive and the SSD to the lowest rungs to allow for better airflow toward the GPU.

It lives!

It's alive! OK, so it wasn't really dead to begin with, we'll admit, but it was certainly in dire need of some TLC. The Intel Core i7-3820 at its heart was an intriguing part for its time. Competing directly with the Core i7-2700K, it made little sense in the PC ecosystem, much like Intel's current Kaby Lake X parts do. A quad-core Extreme Edition processor, back in the 32nm days? Odd. That said, it served its purpose, and played all the latest games and the programs needed to produce a magazine without a hiccup.

The build process, despite the excessive levels of dust and blackened hands we ended up with during construction (we're still not sure what caused that; mold probably), was a relatively painless process. Using compressed air helped a ton with the initial clean-up, and after removing the fans and going over the whole build with a microfiber cloth, it started to resemble a new chassis again. We have to give credit to BitFenix's design team from back in the day, because this case is still fantastic to build in. Especially if you have a modular power supply. Fortunately, our Shinobi isn't the windowed version, so cable management in this build was less about aesthetics and more about function than anything else.

But it's all about performance, and although neither storage nor memory capacity have changed much with this upgrade, the key components — CPU and GPU — have. And what a difference they've made! Single and multicore performance saw almost a 50% improvement in performance, with graphics performance stomping its way up by a massive 100% in some cases.

In its day, AMD's Radeon R9 390 was an incredible piece of flagship technology, but comparing it to Nvidia's Pascal architecture is akin to comparing an ant to a cat. The difference is staggering.

It's difficult for us, in the short term at least, to quantify just how much of a change the additional cooling solutions have added to this build, especially as we've swapped over processors, as well. Hopefully, the IP67 ratings on the CPU cooling fans should ensure they last much, much, *much* longer than the Thermaltake stock fans that came with the previous AIO.

Things that are still due an upgrade? Outside of the case, there's not a lot. It fits the bill perfectly for the tasks we need it to do. Perhaps a Samsung 850 Evo would make more sense as a primary OS drive, because those read speeds are a little on the slow side, but aside from that, it's all set for another five years of hard labour. At least until the case begins to rot away... ■

BENCHMARK RESULTS

	APC LABS TEST PC	THIS SYSTEM
CINEBENCH R15 MULTI-THREAD	602	870 (45%)
CINEBENCH R15 SINGLE-THREAD	125	184 (47%)
TECHARP'S X264 HD 5.0.1 (FPS)	13.19	21.39 (62%)
CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)	532	526 (-1%)
CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S)	224	227 (1%)
RISE OF THE TOMB RAIDER (FPS)	37	77 (108%)
THE DIVISION (FPS)	63	112 (78%)
3DMARK: FIRE STRIKE (INDEX)	57	108 (89%)

Our Labs test PC for this build was the system prior to its upgrades, featuring an Intel Core i7-3820, 16GB (4x 4GB) of quad-channel DDR3, a Sapphire Radeon R9 390, and a 250GB Samsung 840 Evo.

Run your own Pi-powered chat server

Mayank Sharma helps you talk to the world, or just your closest friends, with a personal Raspberry Pi chat server that only you run.

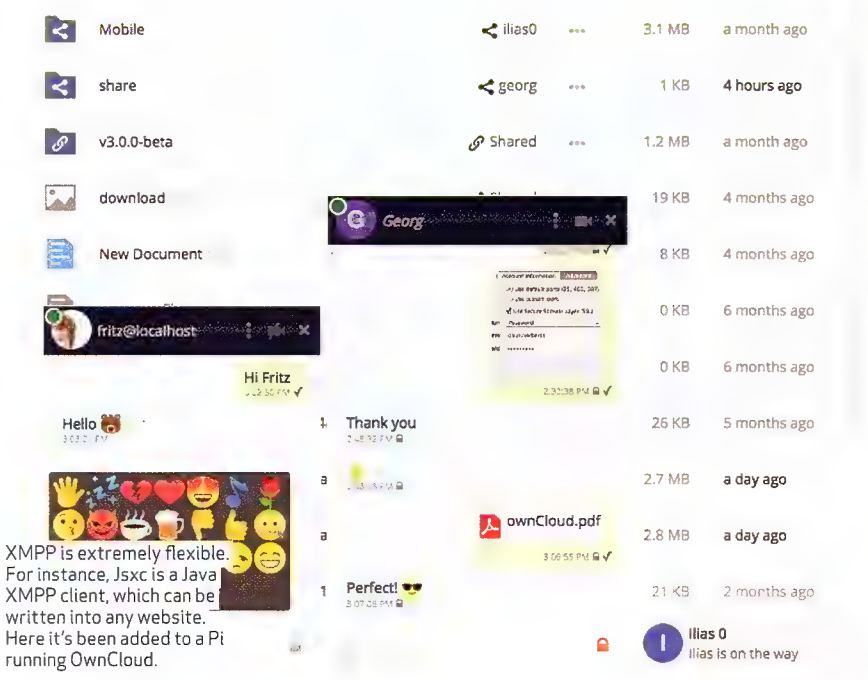
With Facebook Chat, Google Hangouts, Yahoo Messenger and ICQ to name but a few, there's certainly no shortage of chat services today. The downside of all these services is that they're closed-source, meaning the code used to design them isn't released to the public. This makes it harder to detect security vulnerabilities, as well as the fact that you have to trust that big companies are keeping your private conversations safe.

Federation is also definitely not supported by most proprietary chat software – for instance, someone using the official Google Hangouts app has no way of speaking directly to someone using AOL Messenger – which has just closed.

The solution to all of the above is XMPP (Extensible Messaging and Presence Protocol). In essence, XMPP is a communications protocol for open-source and secure messaging. Unlike the chat software created by big corporations, there's a number of programs you can use to connect to a server running XMPP, and you don't have to share the contents of your conversation with anyone except your contacts.

There are thousands of public XMPP servers already in existence, some run by large companies and others by private individuals. The Raspberry Pi can easily be used to set up your own XMPP server, to allow your friends, co-workers or family members to connect and chat together.

Part of this project was adapted from a guide put together by Tomas Greno, which can be viewed at **tinyurl.com/apc450-guide**.



XMPP is extremely flexible. For instance, Jsxc is a Java XMPP client, which can be written into any website. Here it's been added to a Pi running OwnCloud.

WHY XMPP?

Before starting this project, you may be wondering why you might want to set up your own chat server on your Pi, given the number of alternatives available. You may also be questioning why you would choose XMPP when, for far less trouble, you could use more familiar software, such as Facebook Messenger, or have your contacts simply meet you in an online chatroom. For a full technical rundown of the technologies underlying XMPP, you can visit the Overview page of the XMPP Foundation at **tinyurl.com/apc450-xmpp**. However, in brief, one of the chief advantages of using XMPP to host your own chat server is security – your messages will never leave the server, so provided your Raspberry Pi never leaves your home or office, it will be much more difficult for someone to read your chat history.

Even if you permit others to connect to your Pi chat server over the internet, you'll be using open-source software that's regularly reviewed by a community of developers, rather than by one team at a single company. This means that there's a far greater chance of vulnerabilities being discovered and fixed.

XMPP is also extremely flexible. Any XMPP server that is connected to the internet can communicate with any other user registered with another XMPP server.

For example, if you register a chat account with the popular German XMPP server **www.jabber.de**, you can still communicate with someone who has an account with the British XMPP server **www.xmpp.is**. Usernames are written in the style of email addresses, such as hansgruber@jabber.de, and you can add them as contacts in your messaging app.

There's a great many XMPP messaging programs available for both computers and mobile devices. Apple's Messages for Mac OS X and the program Empathy, which comes preinstalled with many versions of Linux, both support the XMPP protocol. For Windows users, it's very easy to download a compatible client.

CHOOSE YOUR CLIENT

To connect to your Pi's server, we will be using the program Pidgin, because it's very flexible and is available for Windows, Mac and Linux. If you're a Mac or Windows user, head over to **www.pidgin.im/download** to download Pidgin Messenger. If you're using Linux, simply install it using your OS's package management tool.

Although when following the tutorial you'll already have added an admin account, this shouldn't be for daily use, so we'll create a new account when starting Pidgin.

When the Pidgin window opens, select XMPP under Protocol. As we're creating a new account, the username can be

anything you want. In the Domain field, put the IP address or domain name of your Raspberry Pi, such as 192.168.1.2. The password field can contain any value you like. It's a good idea at this stage to tick the Remember Password box, to save having to log in each time.

The Local Alias field is simply the name you wish to appear on your own version of Pidgin, to help you distinguish your account – for example, Roger-Raspberry-Pi. Tick Create a New Account on This Server, then Add.

Pidgin is not available for Android devices or iPhones. You can view a full list of XMPP clients for all platforms at **xmpp.org/software/clients.html**. Free apps for iPhone include ChatSecure and AstraChat. Both are available from the iTunes Store. Cost-free Android XMPP apps include Zom Android and Beem, both of which are available in the Google Play Store.

As you will have seen when setting up, Pidgin supports a number of protocols, such as AOL Instant Messenger, Google Talk and Yahoo Messenger. It's also highly customisable through the use of extra plugins. Some, such as Theme Manager, are official and accessed by clicking the Tools menu in Pidgin, then Plugins. Other plugins have been developed by third parties. A full list of third-party plugins, as well as instructions for installation, is available from **developer.pidgin.im/wiki/ThirdPartyPlugins**.

One particular plugin of note is Off-the-Record Messaging (OTR). In brief, if this plugin is installed in both your copy of Pidgin and that of your friends or colleagues, your conversations are automatically encrypted. Unlike the SSL certificate, which is stored on the Pi, OTR encryption keys never leave your computer, so even the chat server can't keep a meaningful copy of your transcripts.

If you want to access the chat server securely from a mobile device, try Zom. This free app (formally Chatsecure) is available for both Android and iPhone, and supports OTR messaging out of the box, without needing to install extra plugins. More information is available from the project's website at **zom.im**.

If you are considering opening your Pi chat server to the internet, another useful plugin is Bot Sentry. This prevents you from being overwhelmed with spam messages, as you only receive messages from people on your buddy list.

Once Pidgin is secure, you may want to tweak its appearance, so head over to **www.pidginthemes.com**.

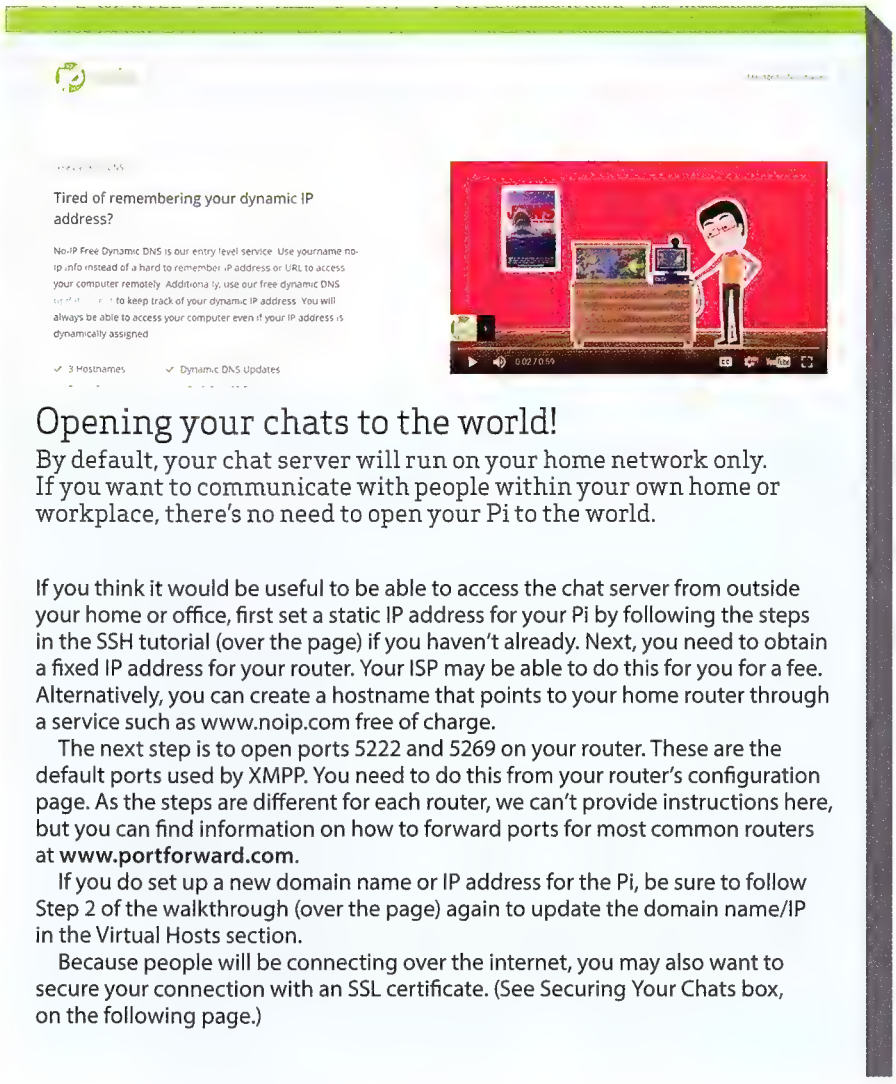
CHAT CHALLENGES

As you'll see in the walkthrough (page 66), the software is very simple to set up and run. If you're having trouble installing the software in the first place, you should make sure you have the latest version of Raspbian. Open Terminal on the Raspberry Pi or connect via SSH and run the command `sudo apt-get update` then `sudo apt-get upgrade`. The second command may take some time, so make sure you don't need to use the Pi urgently before running.

As you're going through the walkthrough, you may have difficulty finding the sections you have to edit in the configuration file. Use 'Ctrl-W' to run a search within the file for the sections you need to change – for example, VirtualHost. Just type your search term and press Return to be taken to the word in question.

If you restart the Pi for any reason, the Prosody chat service stops. You can get it running again by opening Terminal on the Pi or connecting via SSH and running the command `sudo /etc/init.d/prosody start`.

If you find the software fails to start, try running the command `sudo luac -p prosody.cfg.lua` to check the


Tired of remembering your dynamic IP address?
No-IP Free Dynamic DNS is our entry level service. Use yourname.no-ip.info instead of a hard to remember IP address or URL to access your computer remotely. Additionally, use our free dynamic DNS
to keep track of your dynamic IP address. You will always be able to access your computer even if your IP address is dynamically assigned
3 Hostnames
Dynamic DNS Updates

Opening your chats to the world!

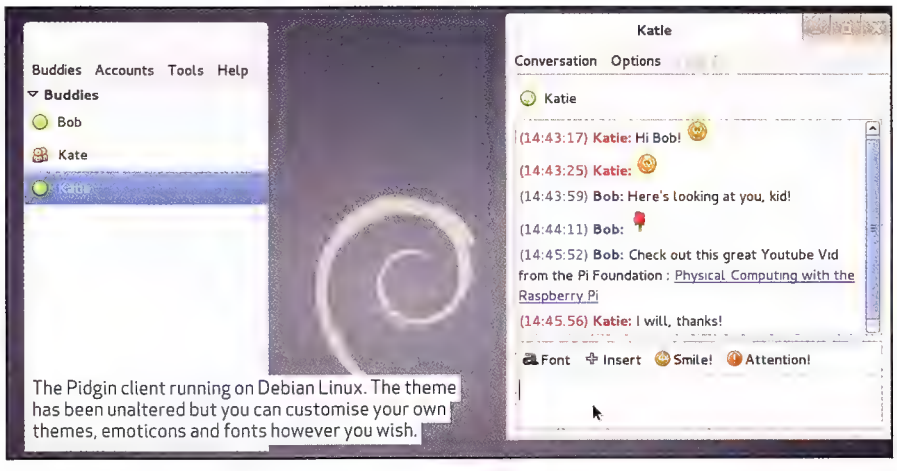
By default, your chat server will run on your home network only. If you want to communicate with people within your own home or workplace, there's no need to open your Pi to the world.

If you think it would be useful to be able to access the chat server from outside your home or office, first set a static IP address for your Pi by following the steps in the SSH tutorial (over the page) if you haven't already. Next, you need to obtain a fixed IP address for your router. Your ISP may be able to do this for you for a fee. Alternatively, you can create a hostname that points to your home router through a service such as www.noip.com free of charge.

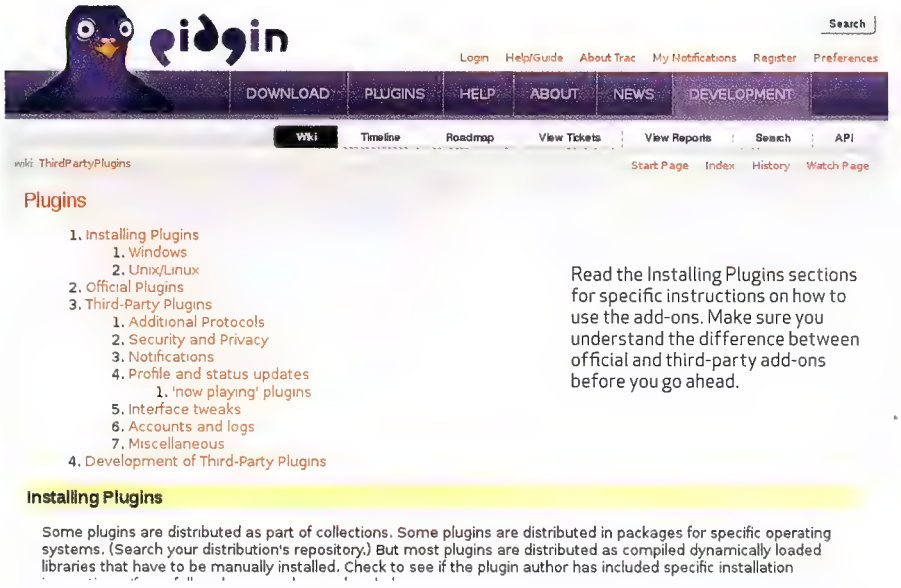
The next step is to open ports 5222 and 5269 on your router. These are the default ports used by XMPP. You need to do this from your router's configuration page. As the steps are different for each router, we can't provide instructions here, but you can find information on how to forward ports for most common routers at **www.portforward.com**.

If you do set up a new domain name or IP address for the Pi, be sure to follow Step 2 of the walkthrough (over the page) again to update the domain name/IP in the Virtual Hosts section.

Because people will be connecting over the internet, you may also want to secure your connection with an SSL certificate. (See Securing Your Chats box, on the following page.)



The Pidgin client running on Debian Linux. The theme has been unaltered but you can customise your own themes, emoticons and fonts however you wish.


pidgin
Search
Login Help/Guide About Trac My Notifications Register Preferences
DOWNLOAD PLUGINS HELP ABOUT NEWS DEVELOPMENT
Wiki Timeline Roadmap View Tickets View Reports Search API
wiki: ThirdPartyPlugins
Start Page Index History Watch Page
Plugins
1. Installing Plugins
1. Windows
2. Unix/Linux
2. Official Plugins
3. Third-Party Plugins
1. Additional Protocols
2. Security and Privacy
3. Notifications
4. Profile and status updates
1. 'now playing' plugins
5. Interface tweaks
6. Accounts and logs
7. Miscellaneous
4. Development of Third-Party Plugins
Installing Plugins
Some plugins are distributed as part of collections. Some plugins are distributed in packages for specific operating systems. (Search your distribution's repository.) But most plugins are distributed as compiled dynamically loaded libraries that have to be manually installed. Check to see if the plugin author has included specific installation

Read the Installing Plugins sections for specific instructions on how to use the add-ons. Make sure you understand the difference between official and third-party add-ons before you go ahead.

configuration file. If all is well, the Terminal simply goes on to the next line when you press Return. Otherwise, it tells you the line where there is an error message.

If you choose to enable SSL, modify the location of both the KEY and CRT file. If you used the Prosody software to generate a self-signed certificate, this is in the same folder. Some messaging clients may display a warning before connecting. This isn't in itself a cause for concern but it may prevent certain programs from being able to connect.

LOCKED DOWN

If you choose only to access the server from your home or office network, remember that your conversations are only secure if no one can physically access your Pi. If you don't use OTR messaging, anyone connected to the network may also be able to read your messages by viewing network traffic. See **prosody.im/doc/security** for a rundown of possible vulnerabilities as well as suggestions on how to solve them. If you do use OTR messaging, bear in mind that chatrooms aren't currently supported.

Voice and video calls are supported by an extension to the XMPP protocol known as Jingle. Not all XMPP clients support this feature. For instance, voice and video calls are only available from the Apple Mac and Linux versions of Pidgin. Linux's built-in messenger, Empathy, also supports Jingle out of the box, as does Jitsi, which is available for Linux, Mac and Windows.

If your contacts only use Windows, they can download a different client, such as Psi (available from **psi-im.org**), which may support video calling. Alternatively, Windows 10 users can install the Linux version of Pidgin via the Windows 10 Bash shell. See **docs.microsoft.com/en-au/windows/wsl/about** for details.

If you have a number of users performing large file transfers or video calling, you may notice the chat server starts responding more slowly. You can relieve this, at least in part, by enabling data compression on your server. See the steps outlined at **prosody.im/doc/modules/mod_compression** for more information. Compression is set on a sliding scale from 1 to 9, where 9 is the highest, but uses the most system resources, which in turn could actually slow the Pi down further. We suggest you start at 7, as the Prosody website suggests, and increase as necessary.

Although XMPP software is very robust and powerful, you may find that some people are reluctant to join your server because they are more familiar with chat services such as Facebook or Google Hangouts and/or they know how to use the client. The best remedy is to provide your contacts with some information on the protocol and what it can do for them. A good place to start is the XMPP Foundation's wiki at **wiki.xmpp.org/web/Philosophy_overview**.

If you do persuade people to use your chat server, you may want to set up a dedicated chatroom for everyone. You need to specify this in your configuration file. For more details on this visit **prosody.im/doc/chatrooms**.

Prosody is extremely lightweight, which makes it ideal for running on the Pi. The downside to this is that you may need special features that aren't available. One example would be the ability to broadcast a message to everyone who is online, which isn't natively supported. Fortunately, there is a large number of add-ons for Prosody, known as modules. Head over to **modules.prosody.im** to see a list of those available. If you see any you think would be useful, download them to your Pi and follow the steps at **prosody.im/doc/installing_modules**. A restart may be needed for the module(s) to take effect.

Happy Chatting!

Securing your chats

If you want to be sure your connection is safe, you can use an SSL certificate to encrypt the connection each time your messaging client passes the password to the Raspberry Pi.

If you wish to connect your Pi's chat server to the internet, it's best to obtain your certificate from a legitimate certificate authority. This also makes it easier for your chat server to authenticate itself to other XMPP chat servers over the internet.

Alternatively, you can generate your own self-signed certificate. This is generally considered less secure, and some XMPP messaging programs may refuse to connect to it, but it's easier to set up. First, open Terminal on the Pi or connect via SSH and run the command: `sudo prosodyctl cert generate yourhostname`

For example: `sudo prosodyctl cert generate 192.168.1.2`

You are asked a series of questions, such as your key size, country and so on. Press Return to accept the default options in every case, except when you're asked for the Common Name. Here, you should type your chat server's IP address — 192.168.1.2, for example. When you're done, the system tells you where it has stored the CRT file. Make a careful note of this. Next, open the prosody configuration file with the command:

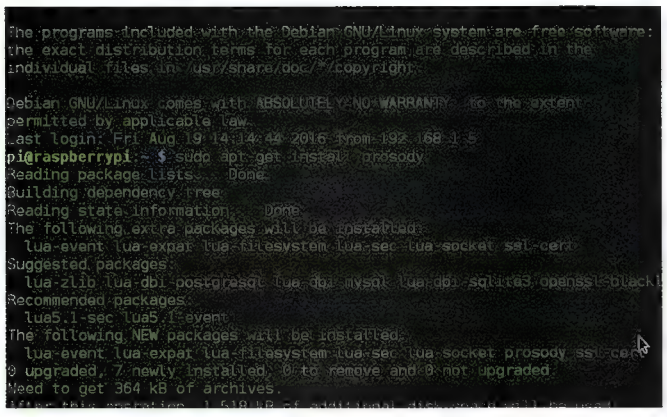
```
sudo nano /etc/prosody/prosody.cfg.lua
```

Scroll down to the section marked `ssl =` and edit with the correct path to your files, such as:

```
ssl = {
  key = "/var/lib/prosody/192.168.1.2.key";
  certificate = "/var/lib/prosody/192.168.1.2.crt";
}
```

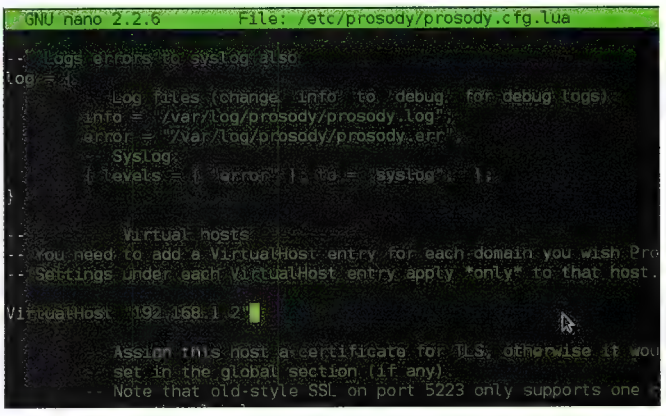
Press 'Ctrl-X', then Y, then hit Return to save your changes.

Set up your Pi chat server


The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Fri Aug 19 14:14:44 2016 from 192.168.1.5
pi@raspberrypi ~ $ sudo apt-get install prosody
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following extra packages will be installed:
lua-event lua-expat lua-filesystem lua-sec lua-socket ssl-cert
Suggested packages:
lua-zlib lua-dbi-postgresql lua-dbi-mysql lua-dbi-sqlite3 openssl-blacklist
Recommended packages:
lua5.1-sec lua5.1-event
The following NEW packages will be installed:
lua-event lua-expat lua-filesystem lua-sec lua-socket prosody ssl-cert
0 upgraded, 7 newly installed, 0 to remove and 0 not upgraded.
Need to get 364 kB of archives.

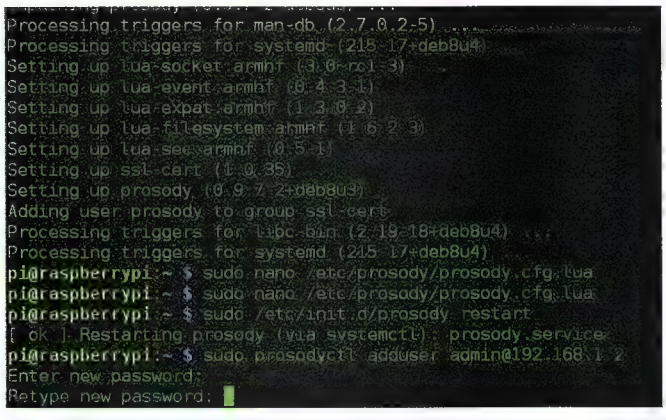
1 INSTALL PROSODY

Open Terminal on your Raspberry Pi or connect via SSH and run the command `sudo apt-get install prosody`, then press Y to confirm you want to install the software on your device. In the next step, you'll need to change your configuration, so run `sudo nano /etc/prosody/prosody.cfg.lua`.


GNU nano 2.2.6 File: /etc/prosody/prosody.cfg.lua
-- Logs errors to syslog also
log = {
-- Log files (change info to debug for debug logs)
info = "/var/log/prosody/prosody.log";
error = "/var/log/prosody/prosody.err";
-- Syslog:
{ levels = { "error" }; to = "syslog"; };
}
-- Virtual hosts
-- You need to add a VirtualHost entry for each domain you wish Pro
-- Settings under each VirtualHost entry apply *only* to that host.
VirtualHost "192.168.1.2"
-- Assign this host a certificate for TLS, otherwise it wou
-- set in the global section (if any)
-- Note that old-style SSL on port 5223 only supports one

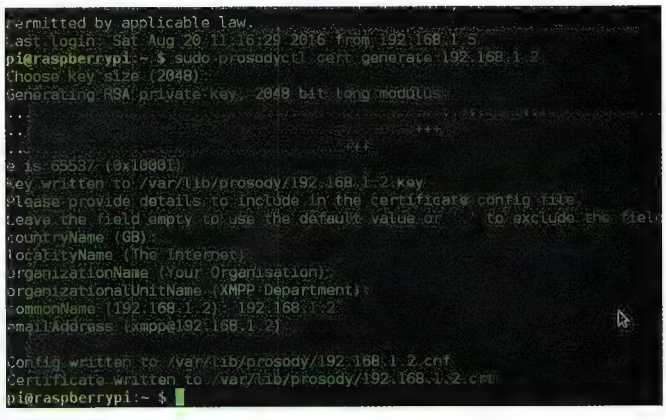
2 MODIFY CONFIG FILE

Scroll to the section Virtual Hosts and change "example.com" to your domain — like, "192.168.1.2". Scroll to the section named Server Wide Settings and, under Admins, change `admins = {"admin@yourip"}` to `admins = {"admin@192.168.1.2"}`, for example. Next, search for "allow_registration" and change to `true`. Press 'Ctrl-X', Y, then Return to save and exit.


Processing triggers for man-db (2.7.0.2-5) ...
Processing triggers for systemd (215-17+deb8u4) ...
Setting up lua-socket:armhf (3.0~rc1-3) ...
Setting up lua-event:armhf (0.4.3-1) ...
Setting up lua-expat:armhf (1.3.0-2) ...
Setting up lua-filesystem:armhf (1.6.2-3) ...
Setting up lua-sec:armhf (0.5-1) ...
Setting up ssl-cert (1.0.35) ...
Setting up prosody (0.9.7-2+deb8u3) ...
Adding user prosody to group ssl-cert
Processing triggers for libc-bin (2.19-18+deb8u4) ...
Processing triggers for systemd (215-17+deb8u4) ...
pi@raspberrypi:~ $ sudo nano /etc/prosody/prosody.cfg.lua
pi@raspberrypi:~ $ sudo nano /etc/prosody/prosody.cfg.lua
pi@raspberrypi:~ $ sudo /etc/init.d/prosody restart
[ok] Restarting prosody (via systemctl): prosody.service.
pi@raspberrypi:~ $ sudo prosodyctl adduser admin@192.168.1.2
Enter new password:
Retype new password:

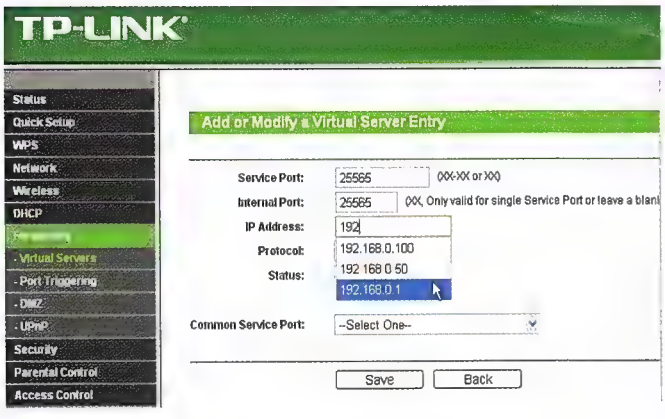
3 RESTART AND ADD AN ADMINISTRATOR

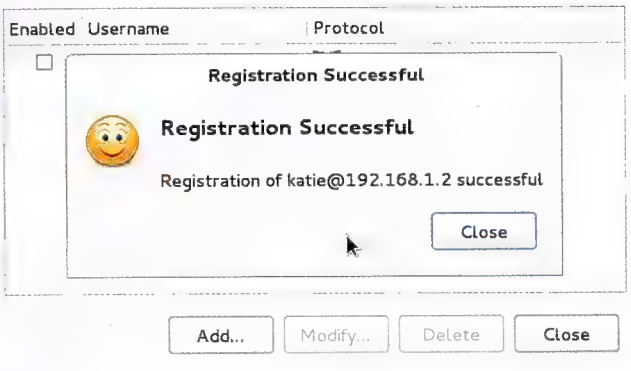
Run `sudo /etc/init.d/prosody restart` to restart Prosody. Next, add an administrator account with `sudo prosodyctl adduser admin@yourdomain`, where "yourdomain" could be `192.168.1.2`. You're asked to type an administrator password. Do so and press Return. Retype the password and then press Return once again.


permitted by applicable law.
Last login: Sat Aug 20 11:16:29 2016 from 192.168.1.5
pi@raspberrypi:~ $ sudo prosodyctl cert generate 192.168.1.2
Choose key size (2048)
Generating RSA private key, 2048 bit long modulus
e is 65537 (0x10001)
Key written to /var/lib/prosody/192.168.1.2.key
Please provide details to include in the certificate config file
Leave the field empty to use the default value or '.' to exclude the field
CountryName (GB):
LocalityName (The Internet):
OrganizationName (Your Organisation):
OrganizationalUnitName (XMPP Department):
CommonName (192.168.1.2): 192.168.1.2
EmailAddress (xmpp@192.168.1.2):
Config written to /var/lib/prosody/192.168.1.2.cnf
Certificate written to /var/lib/prosody/192.168.1.2.crt
pi@raspberrypi:~ $

4 GENERATE A SSL CERTIFICATE

This step is optional but recommended. At this stage, you may wish to generate an SSL certificate to allow messaging clients to connect securely to your server. Follow the steps in Securing Your Chats (opposite) to do this.





5 MAKE IT ACCESSIBLE OVER THE INTERNET

If you only want to use the chat server in your home or office, this step isn't necessary. However, if you want to be able to chat to people in the world at large, follow the steps outlined in Opening Your Chats to the World Wide Web (back over the page).

6 CONNECT WITH AN XMPP CLIENT

Finally, use Pidgin or another XMPP-compatible program to connect to your chat server. Provide the details to your friends or co-workers to make sure that they can connect, too. And that's it — you're ready to chat away to your heart's content.

Jam some Wi-Fi with a Pi

Nate Drake offers you a way to stay safe from cyberterrorists and pesky wardrivers by harnessing Dan McInerney's Wi-Fi jamming script.

As Alfred notes in *The Dark Knight*, some men just want to watch the world burn. This is especially true for impressionable 'script kiddies' who first discover hacking tools. Filled with youthful exuberance and high-energy drinks, they eagerly download and run the first tools and programs they find. This would be easy to laugh off as the follies of youth, if not for the fact that, in so doing, they can cause considerable damage.

In this guide, we'll be exploring a rather nightmarish Python script for the Raspberry Pi named wifijammer which makes use of the scapy packet manipulation module to perform deauthentication attacks on access points (AP) and clients in the immediate area. Any clients are forced to attempt to reconnect, performing a virtual 'handshake' with the access point. If the script keeps running then this won't be possible either, so devices such as drones that are controlled by Wi-Fi won't function.

As tempting as it might sound to know that you won't be troubled by naive teenagers and intrusive spy robots, as an ethical hacker, it's down to you to protect your network from these kind of intrusive and annoying attacks. In order to proceed, all you'll need is a Raspberry Pi with a clean install of either Raspbian or Ubuntu MATE, and a wireless card capable of packet injection.

We also strongly recommend running this script on your Pi in an isolated area, to avoid any legal wrangles. Consider investing in a touchscreen for your Pi and a portable battery solution such as the BattBorg (**thepihut.com/products/battborg?variant=1103793752**), which enables you to run your Pi on regular batteries.

JAMMIN' TILL THE JAM IS THROUGH

The wifijammer's scripts default settings are the digital equivalent of exploding a bomb. First, it'll detect your strongest wireless network interface. In other words, the one that supports packet injection and can detect the greatest number of APs. It'll then sequentially hop over every wireless channel each second and identify targets. On the second pass, it'll try to deauthenticate every AP and client within range. If new clients and APs come within range – if your Pi is on the move, say – it'll also detect and attack these.

This kind of attack is extremely broad and only a very inexperienced hacker or someone intent on wreaking havoc would run the script without fine tuning it to their particular needs. Fortunately, wifijammer can also use command line arguments to limit the

The Battelle DroneDefender snaps on to the end of conventional firearms.

Wireless arguments

By default, the wifijammer script will try to send a deauthentication packet to the broadcast address of every access point (AP) that's within range. Most APs ignore such packets, to avoid exactly this kind of attack, so once you're certain that your APs aren't vulnerable, use the command line argument `-d` to skip this.

If your APs use a specific channel then you can also target this, which is a more preferable proposition than hopping across the entire spectrum. See the step-by-step guide (opposite) for information on using these arguments.

If your wireless device isn't particularly powerful you may have more joy deauthenticating devices by increasing the number of packets sent during the wireless attack. To do so, use the argument `-p <number>`. By default the script will send one deauthentication packet each to clients and access points.

If you want to skip over the deauthentication process of a certain MAC address, use the argument `-d` —

Advanced

```
python wifijammer.py -c 1 -p 5 -t .00001 -s DL:3D:8D:JJ:39:52 -d --w
```

- `-c` , Set the monitor mode interface to only listen and deauth clients or APs
- `-p` , Send 5 packets to the client from the AP and 5 packets to the AP from t broadcast address of the AP
- `-t` , Set a time interval of .00001 seconds between sending each deauth (t space')
- `-s` , Do not deauth the MAC DL:3D:8D:JJ:39:52. Ignoring a certain MAC ad… you want to tempt people to join your access point in cases of wanting to use LANs.py or a Pineapple on them.
- `-d` , Do not send deauths to access points' broadcast address; this will speed up the deauths to the clients that are found
- `--world` , Set the max channel to 13. In N. America the max channel standard is 11, but the rest of the world uses 13 channels so use this option if you're not in N. America

For more advanced usage of wifijammer, including limiting the number of APs/clients to deauthenticate, visit **github.com/DanMcInerney/wifijammer**

for example, `sudo python wifijammer.py -s DF:CD:79:58:79:19` . This is particularly useful if you're connecting to your Pi via VNC and want to monitor the output.

The wifijammer script should automatically seek out the most powerful wireless interface and put it into monitor mode. If you want to use a different monitor mode interface use `-i` , for example `sudo python wifijammer.py -i mon5` .

wireless attack to a specific channel or number of clients/devices. See the boxout Wireless arguments (below left).

If this kind of attack sounds familiar to you, it may be because the tool aireplay-ng, which is part of the Aircrack Penetration Testing Suite, can also be used to try to deauthenticate devices from a network. Penetration testers can use this tool to mimic the behaviour of experienced hackers, who will target specific APs and clients, then try to deauthenticate them in order to capture the 'handshake' between devices, which in turn may help them to crack the wireless network password.

KEEP THE LID ON

While the wifijammer script probably wouldn't be used by veteran hackers, it can be difficult to provide your network with absolute protection against deauthentication attacks.

There are steps that you can take, however, to minimise the damage they can cause. In the first instance, run the script without any command line arguments to make sure that your router itself isn't vulnerable to deauthentication attacks. Otherwise, it'll boot all devices off your network in one swift move.

The wifijammer script uses unencrypted deauthentication packets (or frames) to disrupt networks. It's not designed to exploit the handshake between devices and capture your wireless key. However, while you're running your tests, there's no harm in taking the time to make sure your network uses WPA2-PSK (AES) encryption. Make sure the password is sufficiently long (16+ characters) and change it regularly. You may also wish to take this opportunity to flash your router with open source firmware such as OpenWrt or LEDE, which is less prone to security vulnerabilities.

You may also be able to put off casual script kiddies from deauthenticating devices on your network by using MAC Address filtering. (See **wiki.openwrt.org/doc/uci/wireless** for tips on how to configure this for OpenWrt routers). This only makes sense if you have a specific set of devices accessing the network – in an office, for example. MAC addresses are easy to spoof but slightly increases the time and resources a hacker must spend.

Certain routers such as the Cisco WLC 5700 Series use the 802.11w-2009 protocol. This encrypts deauthentication packets using the Management Frame Protection (MFP) service, meaning your AP can tell the difference between a legitimate deauthorisation request and someone trying to attack your network. See **bit.ly/cisco-router** for more information.

JAMMED UP

While the wifijammer script itself is a breeze to download and run, AU's Computer Offenses section of the Criminal Code Act 1995 forbids the unauthorised access of a computer or network of computers. This is very important if you're testing your Wi-Fi jamming script in a workplace as although you may have the permission of the network owner to access their AP, people with wireless clients like laptops and mobile phones may not be so forthcoming.

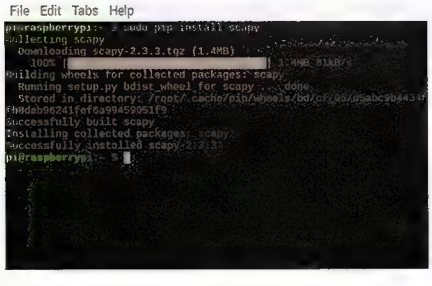
Soldiers on the battlefield can deauthenticate the enemy's drones using the Battelle DroneDefender.

The author managed to segue his way round this legal obstacle by taking a Robinsonade journey to a remote island, then running the script with no wireless devices nearby besides those he brought with him. Use the Pi's network manager to make sure no other APs are in range before running your tests to stay within the law.

Certain Wi-Fi devices may not support packet injection, which is necessary for carrying out deauthentication attacks.

The Aircrack-ng maintains a list of chipsets that support this feature. The Racksoy Professional Ralink 5370 Wi-Fi Dongle, for instance, supported packet injection but was unable to hop between channels when inserted into the Pi. If this happens, you can either try a different wireless device or try a different operating system on your Pi such as Ubuntu MATE, which uses a more recent version of the Linux kernel, so may have better support for various chipsets.

Grasp the basics of Wi-Fi jamming



1 INSTALL PREREQUISITES

Insert a Wi-Fi device capable of packet injection. Check that the Pi can detect it by opening Terminal on your Pi and running the command `ip a`. Next, install the scapy packet manipulation tool with `sudo pip install scapy` then clone the wifijammer tool from Github by running `git clone https://github.com/DanMcInerney/wifijammer.git`. Change to the wifijammer directory with `cd wifijammer`.

2 START WIFIJAMMER SCRIPT

If you want to start the script with default settings then run `sudo python wifijammer.py`. It will search for the most powerful wireless interface and turn on Monitor Mode. It will then hop over all available wireless channels, identifying both access points and any connected clients. Next, it'll then send a deauthentication signal from each client to the AP and vice versa.

3 USE OPTIONAL ARGUMENTS

If you wish to try a more targeted attack, as we strongly recommend, press 'Ctrl-C' to stop the script if it's running. For instance, to only try deauthenticate clients or access points on channel 6, run `sudo python wifijammer.py -c 6`. You can also use the argument `-d` to skip sending deauthentication packets to access point's broadcast addresses, because most simply ignore these.

The BioLite turns heat into electricity, enough to charge your phone.

Android Battery Charging 101

Everything you need to know about charging your phone in minimum time — and it shouldn't involve lemons. Darren Yates explains.

When it comes to stretching your phone's battery life, we all know the drill — turn off any feature you don't need, basically. But what about charging the battery back up again? There are plenty of technologies involved in battery charging these days, but no matter which tech your phone uses, there are still basic laws of electronics in play, which makes some of the things you read online serious 'head-desk' moments. So this month, we'll give you the good oil on everything to do with phone battery charging and why your phone is likely to be charging slower than it probably should.

LEMONS WON'T WORK

One of the things that prompted this topic this month was a story I read recently on an Australian mainstream media website advocating ways to charge your phone when there's no available power. One way — apparently — is to build a fruit battery. The seemingly-serious article began with a nod to this method being 'dodgy', but then happily continued explaining how it works anyway. It turns out — apparently — that "pieces of acidic fruit" alternately connected via copper and zinc nails 'theoretically' should "generate enough power to charge your phone".

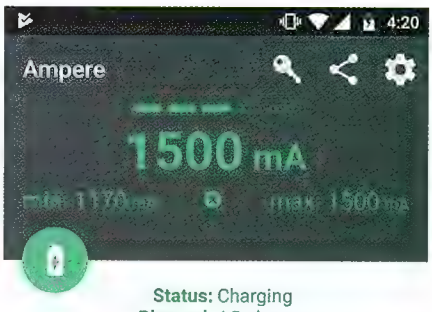
Cow cookies! This is why we need more science in schools — so that kids build a lemon battery and see that it can no more than dimly light an LED, let alone charge a phone! Yes, you can build a fruit battery to generate the 5VDC your phone's USB port requires, but voltage is only half of the equation defining electrical power:

Power (W) = Voltage (V) x Current (I)

The other half is electrical current. Batteries store energy and the unit of measurement for this is 'milliamp-hours' (mAh). It, too, has a simple mathematical equation that works like this:

Milliamp-hours (mAh) = Current (mA) x Time (hours)

So a battery with 2,500mAh capacity can supply 2,500mA of current for one



Status: Charging
Plugged: AC charger
Level: 65%
Health: Good
Technology: Li-ion
Temperature: 27.2 °C
Voltage: 4.218 V

Model: Moto G (5)
Android version: 7.0
Build ID: NPPS25.137-15-11

Ampere is a free Google Play app for measuring current flow in your phone.

PROPERTY
orth Point, NSW

If anyone tells you a few lemons will charge your phone's battery, just run.

You'll need a QuickCharge-ready adapter to max most new fast-charge phones.

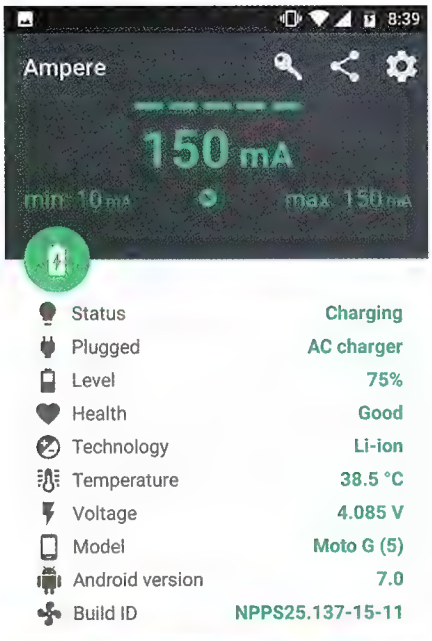
Not all USB cables are created equal — thinner, longer cables may cause issues.

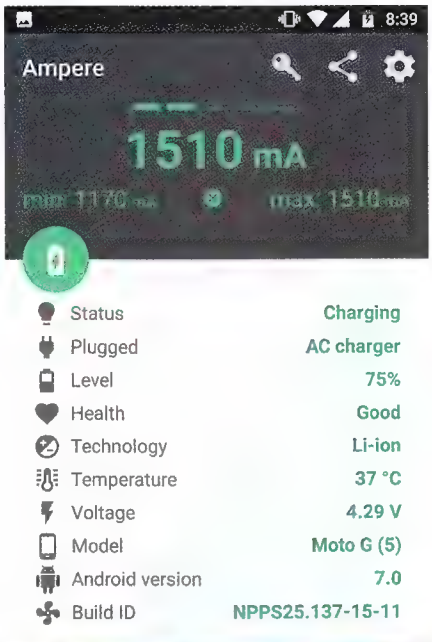
hour, or 1,250mAh of current for two hours and so on (there is some wriggle room here, but the basics hold true).

However, in order to charge the battery back up again, you essentially need to do the same thing in reverse — charge the battery at certain current rates for a certain time. You can hit a 2,500mAh battery with 2,500mA of current for an hour to charge it back up, or 1,250mA of current for two hours and so on (it's not quite this simple, but still, you get the idea).

Yet even flying downhill with a tail wind, your average lemon battery will supply no more than 1mA of current. Even at that rate, you're looking at 2,500 hours minimum to charge up a 2,500mAh battery — that's three months! In practice however, you'll be waiting into the next millennium. Why? Well, aside from the fact that Lithium-ion batteries have what's known as 'self-discharge' or 'leakage' current of roughly 2% of capacity per month, and aside from the fact that the battery's own protection circuitry chews through another 3% each month, no fruit battery would last that long anyway. What's more, even if you somehow successfully regulated its voltage to 5VDC as required, a typical lemon battery's ability to supply current is so weak, its voltage will collapse under the strain and the phone's circuitry will just switch off.

> "Even if you're only a part-time geek, it doesn't take long for your home to fill up with microUSB cables. They seem to turn up everywhere and when you're in a hurry, it's normal to just grab the nearest one and whack it in."





Two USB cables giving vastly different charge currents on the same phone.

Think of it another way: it's like trying to fill your car's fuel tank through an eyedropper — the fuel will likely evaporate before it hits the bottom of the tank. So a fruit battery to charge your phone? No. Just, no.

OHM'S LAW AND CHARGE CABLES

Even if you're only a part-time geek, it doesn't take long for your home to fill up with microUSB cables. They seem to turn up everywhere and, when you're in a hurry, it's normal to just grab the nearest one and whack it in. After all, a USB cable is a USB cable, right? Not quite.

All electrical wire has some resistance and that resistance increases proportionally with its length. However, resistance also increases inversely proportional to the wire's diameter — in other words, the thinner the wire, the more resistance it will have over a set length. What's my point? German physicist Georg Ohm discovered 200 years or so ago that resistance affects the ability of current to flow through a cable. Thanks to his work, we have Ohm's Law, which states:

Current (I) = Voltage (V) / Resistance (R)

So with a fixed voltage, increased resistance proportionally reduces the current flow. Just because a USB cable has a Type-A connector on one end and a microUSB connector on the other doesn't mean that it will conduct the same amount of electrical current as any other similar USB cable. While you probably won't have a USB cable 100 metres long, you will likely have cables

Most modern phones support charge rates up to 2,000mA.

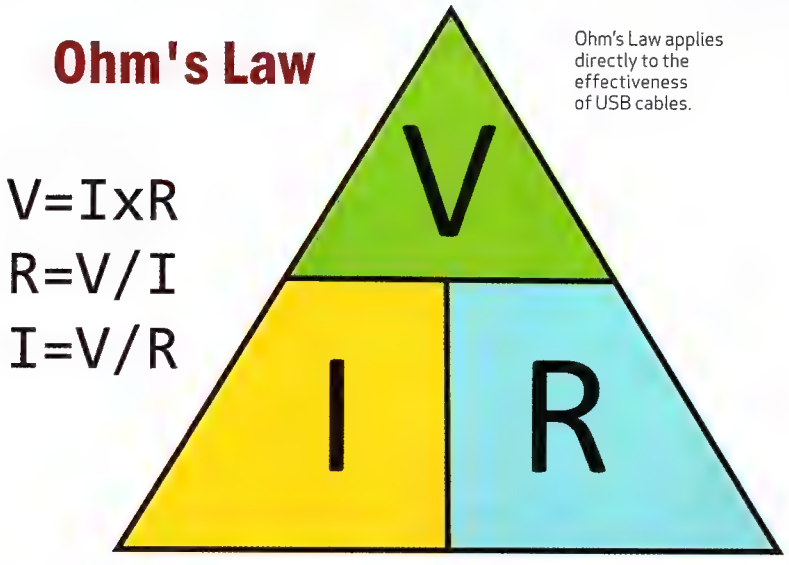
Be careful to use only USBIF-compliant USB-C to USB Type-A cables.

"When it comes to USB battery charging and power delivery specs, charge rates are negotiated between the device doing the charging and the device being charged."

with different thicknesses of wire, affecting the cable's resistance and its ability to carry current.

Just on my desk right now, I have four microUSB cables of various lengths and thicknesses. Connecting up each to a small selection of phones, I get a different charge current rate for each cable. On my Motorola Moto G5 phone, for example, the thinnest cable delivered a charge current of 150mA, while the thickest cable, two seconds later, pumped through 1,510mA into the same device – that's a 10:1 difference, right there.

As we saw before, the time it takes to charge your phone is directly proportional to the current flowing into the phone, so for these two cables, one will take roughly 10 times longer to charge the phone than the other. Forget fancy phone charging tech – your choice of USB cable can have a massive effect on phone charge times.



Ohm's Law applies directly to the effectiveness of USB cables.

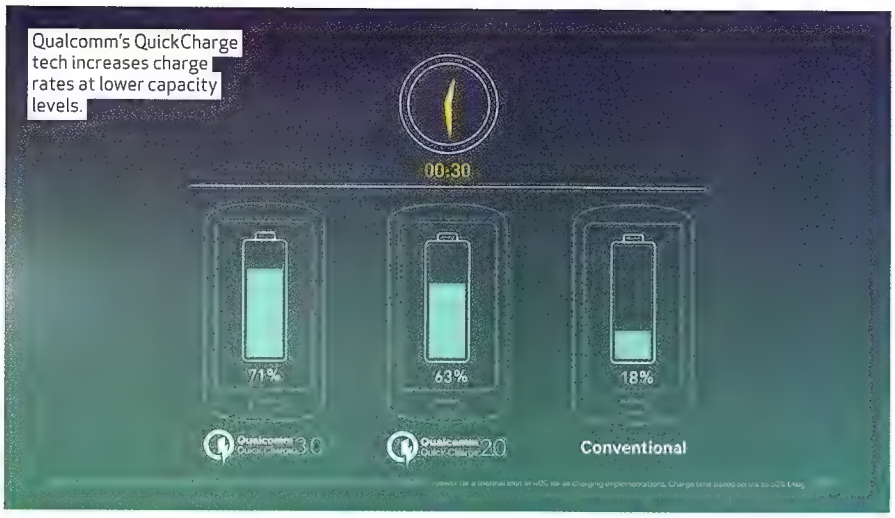
WATCH OUT FOR USB-C CABLES

So here's my rule of thumb – you should get the best charge rate for your phone from the USB cable it came with, but if you don't have that cable with you, go for the thickest and shortest cable (within reason) you can find. The caveat here is new USB-C cables. USB-C is a special case requiring extra precautions to avoid frying your devices. USB-C cables with a USB Type-A connector on the other end have the potential to attempt extracting 3,000mA of charge current from a USB port, whether it's a laptop, PC or USB charge adapter. If the cable is non-compliant and doesn't have the required sense resistor built into it, the excessive power demands will likely damage the charge source. To prevent this, make sure any USB-C to USB2.0/3.0 Type-A cable you use is USBIF-compliant.

BIGGER CHARGE ADAPTERS CHARGE FASTER?

While this 'bigger is faster' idea is pretty common, it isn't strictly true. The mistake many users make is thinking that the power brick solely determines the charging rate – it doesn't. When it comes to USB battery charging and power delivery specs, charge rates are negotiated between the device doing the charging and the device being charged. A phone won't charge faster than it's designed to, even if you plug it into a nuclear reactor. But likewise, a smaller USB charge adapter with a lower output current level will limit the phone's charge rate. Think of these two as links in a chain – the charge rate is limited by the weakest device.

Now at this point, we'd normally suggest the best charge adapter will be the one that came with your phone, but even that's not strictly true anymore. For example, the new iPhone X supports fast-charging, but not with the supplied USB adapter – instead, you have to purchase separately a USB-C power adapter supporting USB Power Delivery



Qualcomm's QuickCharge tech increases charge rates at lower capacity levels.

specs, plus Apple's USB-C to Lightning cable (**tinyurl.com/y8z25fcb**). Apple's 29W USB-C Power Adapter will cost you an extra $69 in Australia, the cable another $35. Ouch.

WHAT IS QUICKCHARGING?

No doubt you've heard of 'QuickCharge' by now, or similar tech from other phone and chip vendors, but what is it and how does it work? QuickCharge is a charging technology developed by chipmaker Qualcomm to increase the speed of battery charging – it's licensed by many phone makers under various names that mostly mean the same thing. The technology is built into most late-model Snapdragon SoC (System on a Chip) CPUs, but that alone is no guarantee of its availability in a phone (see Motorola Moto G5).

The way QuickCharge works is that, instead of the standard 5VDC voltage used by normal USB charge adapters, QuickCharge delivers much the same charge current but at a higher voltage to pump more energy at a faster rate into the phone's battery. This is how Qualcomm can say your phone's battery can go from 0% to 80% charged in as little as 35 minutes. Remember, power equals voltage times current, so if you increase the voltage, you're increasing the electrical energy going into the battery.

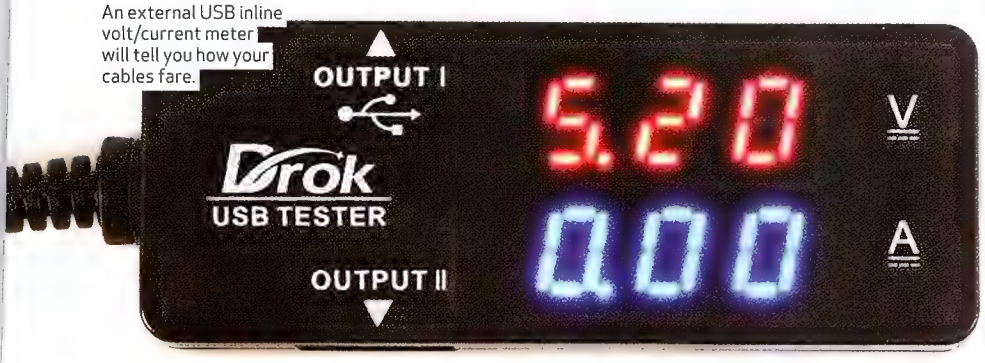
What's really important, though, is that the charge process is controlled – not just by the charge adapter and the phone, but by the battery itself. The battery's internal circuitry ensures the battery isn't overcharged – once the battery's capacity reaches 70–80%, the charge current is progressively reduced. In fact, with fast-charge technology, phones are likely to reach 70% of capacity in less time than it takes to go from 70% to 100%. This is to protect the battery.

Qualcomm now has four generations of QuickCharge, each one faster than the one before. They're also backward-compatible, so a phone with QuickCharge 4.0 tech should fast-charge with a QuickCharge 3.0 or 2.0 or 1.0 charge adapter, just at progressively lower rates. You can find the details on QuickCharge over at the Qualcomm website (**qualcomm.com/products/features/quick-charge**). If you're after a list of QuickCharge-compliant devices, grab the PDF (**tinyurl.com/y9fvddqk**, PDF).

HOW TO PICK GOOD VS BAD CABLES

While QuickCharge can help improve below-par USB cables by virtue of jacking up the voltage, you should still be choosy about the cables you use to charge your phone. The best way to pick good cables from bad is to measure the current flow through the cable. There are two ways to do this – my personal preference is to use a USB in-line volt/current meter, but another equally valid option is to read the internal phone sensors using an app. My choice here is Ampere on Google Play (**tinyurl.com/pxxu3du**). But using either method, you now just test each cable in turn to see which one gives you the greatest current flow.

One more thing – do these tests when you phone's battery is under 70% charged. Much above this and the charge rate will probably have begun to taper off, possibly skewing your results. And where possible, use your phone's supplied charger. Failing that, use a good charger rated to 2-amps (2,000mA) or a QuickCharge-compatible adapter if your phone supports this feature. The idea is to give your phone no excuses for not charging at its maximum rate – that way, any drop in current flow is due solely to the USB cable. Just remember to take care with those USB-C-to-USB Type-A cables.



An external USB inline volt/current meter will tell you how your cables fare.

CHARGING VIA PC IS SLOWER?

You probably also know you can charge your phone via your PC or laptop's USB ports. You may have even noticed that it seems to take longer to charge doing so. Here's why. There are four USB standards in existence – USB 1.0, 2.0, 3.0 and 3.1. Very few systems from the USB 1.0 days will still be around, but you're still likely to see USB 2.0 laptops and PC ports. Standard ports can only supply 500mA of current, so even if your phone handles up to 2,000mA of charge current, it'll only receive 500mA because that's all these ports can deliver. USB 3.0 jacks this up to 900mA of current. The variation is if your PC has a dedicated charging port (DCP) – these ports are capable of punching out 1,500mA of charge current. USB 3.1 ports can unleash 1,500 or 3,000mA of charge current, but again, both the ports and your phone must support USB 3.1 and the higher charge currents to get that 3,000mA rate. In most cases, a 2-amp USB AC adapter should do a better job, but a PC USB port is still better than nothing at all.

ADAPTER, CABLE, PHONE, BATTERY

Maximising charging currents is all about getting your ducks in a row – your charge adapter, your charge cable, the phone and battery. But in the end, if your USB cable is a dud, it's not going to matter which charging technique you use – they'll all be sluggish.

Sure, there are plenty of exotic charging options from solar panels to campfire heat-to-energy converters, but the same basic electronic principles, like Ohm's Law, will always apply. Just don't tell me you're using a lemon battery.

12 LEDs, one wire: Using smart LEDs with Arduino

Light-emitting diodes have gone 'smart'. Darren Yates shows how to use an Arduino Nano to control up to hundreds of RGB LEDs with just one wire.

They've been around since the early 1960s, but light-emitting diodes or LEDs are now taking over the world. They provide indicators in almost every electronic gadget, drive display technologies in phones and TVs, not to mention neighbourhood Christmas light displays. However, more recently, LEDs have gone 'smart' with built-in microcontroller chips, enabling an Arduino board to control hundreds of them with a single data wire.

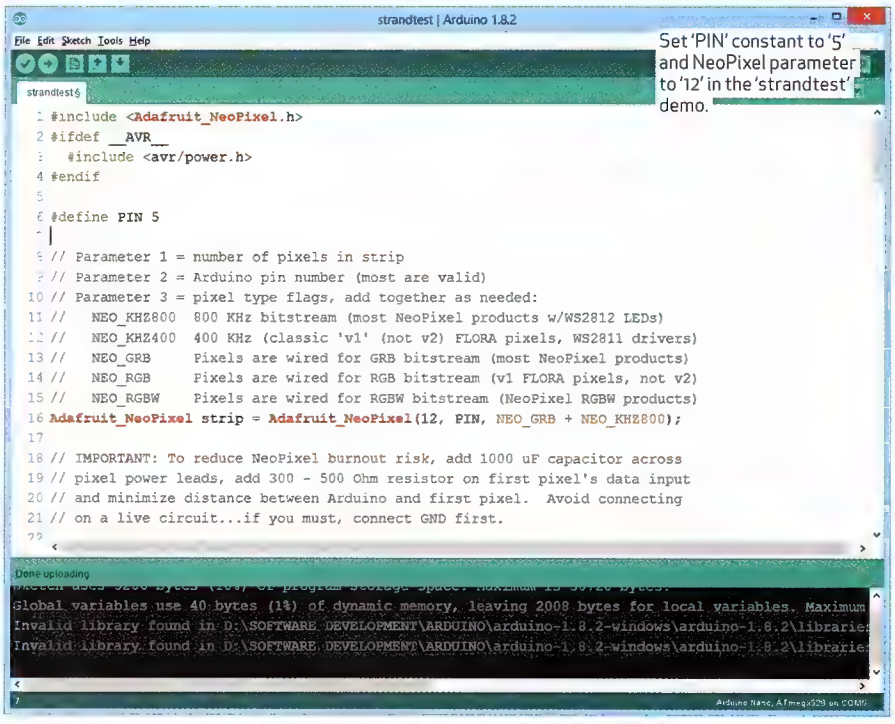
WS2812B RGB LED

PC case modders have stacked out their gaming rigs with LED strips for years, initially single-colour, but more recently with RGB strips, connected to a control box. Using an Arduino instead, you can have ultimate control over each LED and colour sequence.

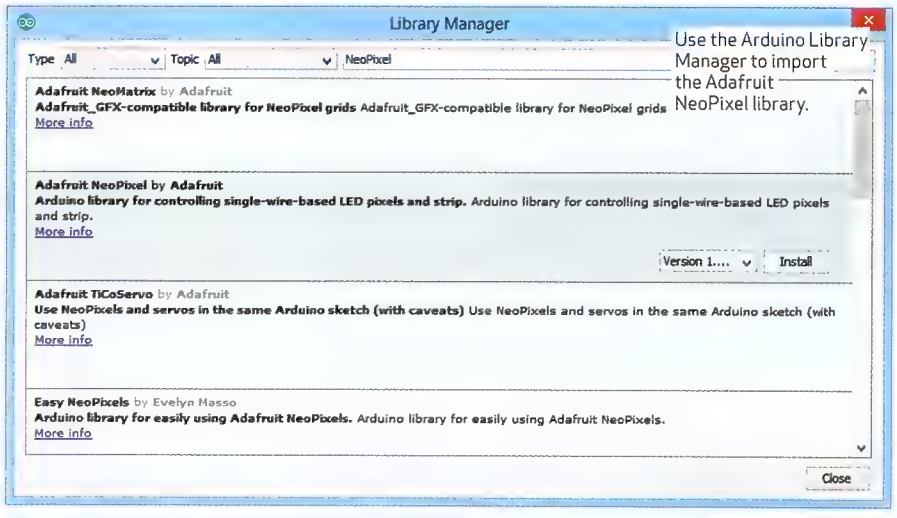
The WS2812B is a four-pin RGB 'intelligent control' LED – two pins for power (5VDC and 0VDC), a pin for 'data-input', another as 'data-output'. It's designed to work in strips, the data-output from one feeding into the data-input of the next, so that you can control hundreds of them using a single Arduino digital I/O pin.

Strip versions typically come in 1–5m lengths with 30, 60 or 144 LEDs per metre density. They're pretty flexible and waterproof versions are available. You can even cut them to size if you have to.

They also come in ring shapes on printed-circuit boards, where each LED is referred to as a 'bit', so a 12-bit LED ring has 12 LEDs. You'll find 1, 4, 7, 8, 12, 16, 24 and 60-bit LED rings available. We'll be using a 12-bit LED ring this month, but the basic electronics ideas we'll consider apply to all forms.


strandtest | Arduino 1.8.2
File Edit Sketch Tools Help
strandtest§
#include <Adafruit_NeoPixel.h>
#ifdef __AVR__
#include <avr/power.h>
#endif
#define PIN 5
// Parameter 1 = number of pixels in strip
// Parameter 2 = Arduino pin number (most are valid)
// Parameter 3 = pixel type flags, add together as needed:
// NEO_KHZ800 800 KHz bitstream (most NeoPixel products w/WS2812 LEDs)
// NEO_KHZ400 400 KHz (classic 'v1' (not v2) FLORA pixels, WS2811 drivers)
// NEO_GRB Pixels are wired for GRB bitstream (most NeoPixel products)
// NEO_RGB Pixels are wired for RGB bitstream (v1 FLORA pixels, not v2)
// NEO_RGBW Pixels are wired for RGBW bitstream (NeoPixel RGBW products)
Adafruit_NeoPixel strip = Adafruit_NeoPixel(12, PIN, NEO_GRB + NEO_KHZ800);
// IMPORTANT: To reduce NeoPixel burnout risk, add 1000 uF capacitor across
// pixel power leads, add 300 - 500 Ohm resistor on first pixel's data input
// and minimize distance between Arduino and first pixel. Avoid connecting
// on a live circuit...if you must, connect GND first.
Done uploading
Global variables use 40 bytes (1%) of dynamic memory, leaving 2008 bytes for local variables. Maximum
Invalid library found in D:\SOFTWARE DEVELOPMENT\ARDUINO\arduino-1.8.2-windows\arduino-1.8.2\libraries
Invalid library found in D:\SOFTWARE DEVELOPMENT\ARDUINO\arduino-1.8.2-windows\arduino-1.8.2\libraries
Arduino Nano, ATmega328 on COM6

Set 'PIN' constant to '5' and NeoPixel parameter to '12' in the 'strandtest' demo.


Library Manager
Type All
Topic All
NeoPixel
Adafruit NeoMatrix by Adafruit
Adafruit_GFX-compatible library for NeoPixel grids Adafruit_GFX-compatible library for NeoPixel grids
More info
Adafruit NeoPixel by Adafruit
Arduino library for controlling single-wire-based LED pixels and strip. Arduino library for controlling single-wire-based LED pixels and strip.
More info
Version 1.... Install
Adafruit TiCoServo by Adafruit
Use NeoPixels and servos in the same Arduino sketch (with caveats) Use NeoPixels and servos in the same Arduino sketch (with caveats)
More info
Easy NeoPixels by Evelyn Masso
Arduino library for easily using Adafruit NeoPixels. Arduino library for easily using Adafruit NeoPixels.
More info
Close

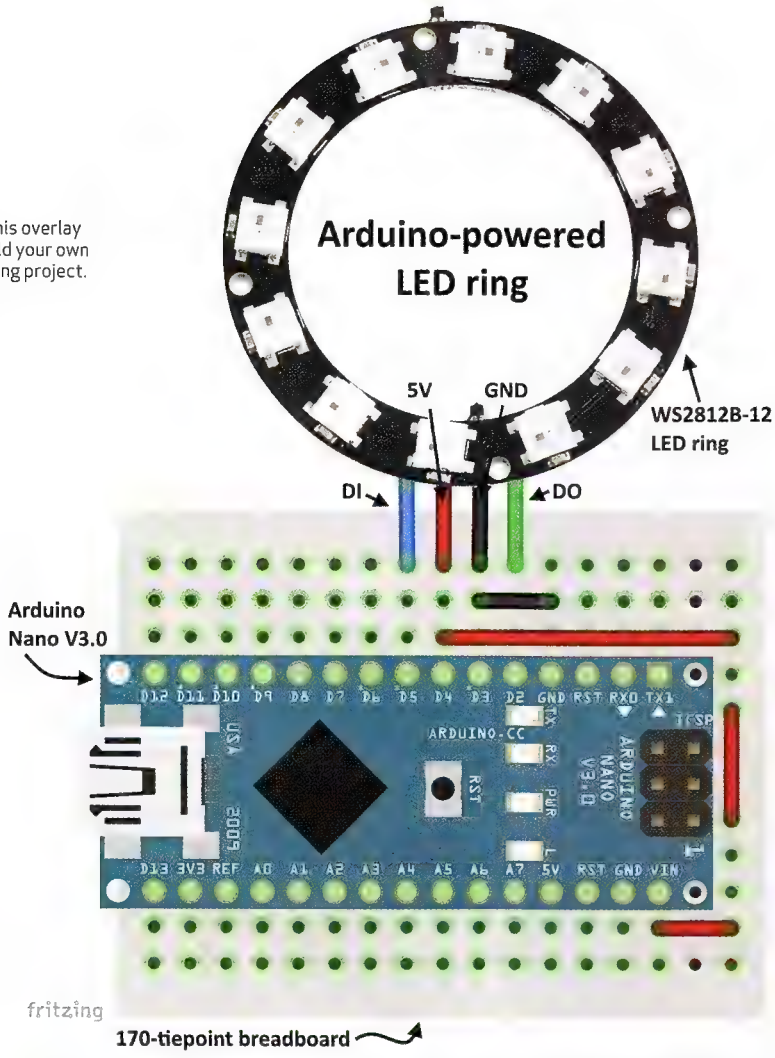
Use the Arduino Library Manager to import the Adafruit NeoPixel library.

GIVE ME POWER

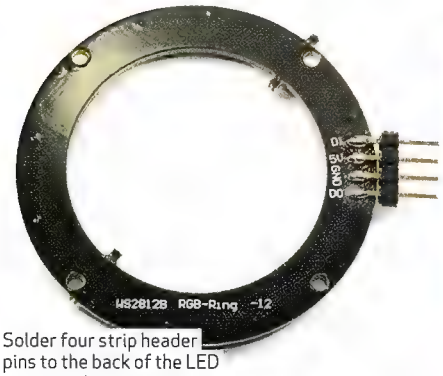
The one thing you must be aware of when using RGB LEDs is that power demands can rack up quickly. For example, each WS2812B RGB LED contains three LEDs – red, green and blue – and each of those can consume up to 20mA of current. Even with our small 12-bit LED ring, you've got 36 LEDs at 20mA each, or 720mA of current when set to maximum brightness – more than the typical USB2.0 port can provide. For longer strips, you can easily rack up 5-amps of current per metre and more without breaking a sweat. Thankfully, you have 8-bit control over the brightness of each colour channel, so it's relatively easy to keep the overall power draw within requirements.

HOW TO CODE

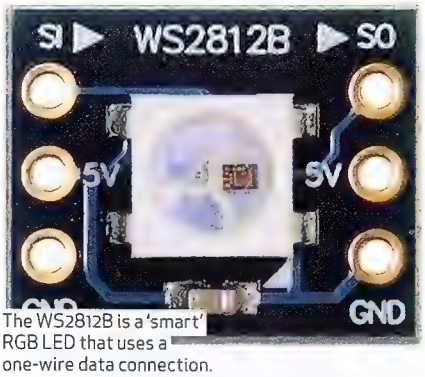
The key to this is in the coding. In fact, Adafruit's excellent NeoPixel library lets you set the brightness with a simple function:



Use this overlay to build your own LED ring project.



Solder four strip header pins to the back of the LED ring to make it easy to use.



The WS2812B is a 'smart' RGB LED that uses a one-wire data connection.

```
strip.setBrightness(bright_level);
```

Here, 'bright_level' is an integer between zero (off) and 255 (full-on). You can also adjust brightness levels when setting the individual LEDs:

```
strip.setPixelColor(n, red, green, blue);
```

There are four parameters here – 'n' refers to the number of the RGB LED in the strip/ring you wish to set, while 'red', 'green' and 'blue' are 8-bit numbers that set the individual colour channel brightness (0 off, 255 full-on). With each of the red, green and blue LEDs having 8-bit levels, you have 24-bits worth of overall colour control.

But you can also use this to set the overall maximum power draw. Since each LED consumes max power when its level is set to '255', ensure that level never exceeds '128', for example, and you'll limit the current flow to half that maximum level. For our 12-bit LED ring, for example, that current would be:

```
current = 12 chips x 3 LEDs x 20mA x (128/256) = 360mA
```

This can be handled by any decent USB2.0-compliant port. Remember, too, each LED would have to show white (all RGB LEDs on) to reach that max current level – as soon as you show predominant red, green or blue, the overall current will drop noticeably.

SOLDER WORK

These LED rings come with solder pads on the back to connect your hook-up wires to, but I find the better option is to solder in place 0.1-inch strip-header pins. These come in breakable strips and using these instead, you can quickly plug in and remove headed 'dupont'-style hook-up wires. If you don't know how to solder, learn or rope in a mate who can.

SIMPLE BUILD EXAMPLE

We've used these strip-headers here, plugging the result straight into a tiny 170-tiepoint breadboard, power by an Arduino Nano. We've routed power to the LED ring from the Nano's 'Vin' pin, which comes hot off the USB port, for two reasons – first, the USB power rail is 5VDC-regulated already and so no extra protection is needed. But second, most Nano boards typically use a small 500mA Schottky rectifier diode connecting the USB power rail to the 5V pin – full-power current drain for the LED ring could damage this diode. Connecting the ring straight to the USB power rail bypasses the diode.

Otherwise, it's a pretty simple project to put together. We bought everything from eBay and it shouldn't cost you more than about $10. Just follow the overlay diagram to build your own.

The only other thing you need is source code – and this month, you'll find this within the Arduino IDE. If you haven't already, download and install the latest Arduino IDE (v1.8.5 at time of writing). Launch it and from the main menu, select Sketch, Include Library, Manage Libraries. When the Library Manager appears, type "NeoPixel" into the search box at top-right. Next, click on the Adafruit NeoPixel library entry and click the Install button. When complete, restart the Arduino IDE, then from the main menu, select File, Examples, scroll down to 'Adafruit NeoPixel' and select 'strandtest'. When you see the code, change the '#define PIN 6' line to '#define PIN 5' and adjust the line:

```
Adafruit_NeoPixel strip = Adafruit_NeoPixel(60, PIN,…
```

To read:

```
Adafruit_NeoPixel strip = Adafruit_NeoPixel(12, PIN,…
```

Now, plug the Arduino Nano board into your PC, select it within the IDE (from the menu, go 'Tools > Board'), choose the correct COM port (not COM1) and flash the source code across. Provided you've built it correctly, the Nano will start and the LED ring light up. Current drain for this demo example on a 12-bit LED ring should be around 150mA.

GIVE IT A GO

I can think of numerous project ideas for these smart LEDs, from bold-and-brassy peak-level or 'VU' meters for music, to simple pixel clocks and crazy monitor backlighting. What's really cool about them, though, is their simple drive control and the excellent software libraries available that make them easy to use. It just needs your imagination. And a decent power supply. ■

Make some noise in Python

Your apps don't have to be silent — learn how to code tones, play audio files and even turn text into speech with Python. Darren Yates shows how.

Writing your own apps will always score you plenty of kudos points, whether you're building machine-learning algorithms or writing 'choose your own adventure' games. But if there's one thing that makes your apps come alive, it's sound. Could you imagine Mario Bros reaching the same heights of popularity without that iconic soundtrack? Computers have made sounds for decades — in fact, Australia owns bragging rights for the first music generated by computer, played on Australia's own first-gen CSIRAC computer as far back as April 1951. We've come a long way since then, and today, Python not only plays computer-generated tones, but standard audio file formats, turns text into speech and even turns its hand to speech recognition.

THE 'WINSOUND' MODULE

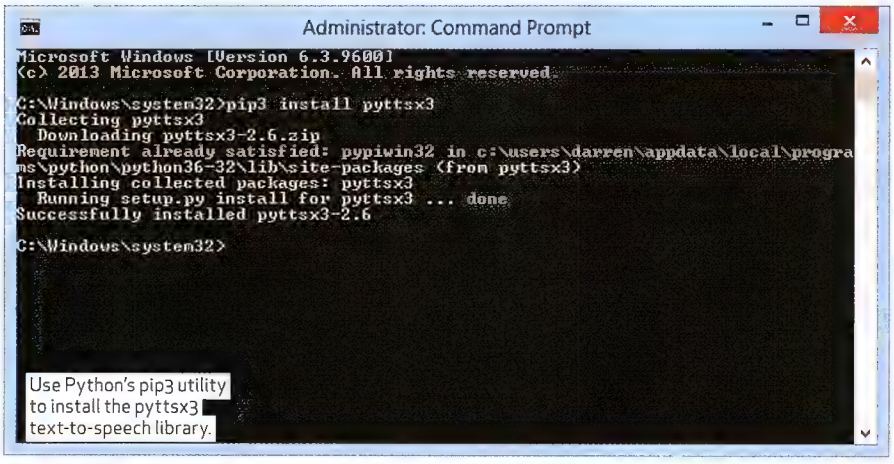
For simplicity and space this month, we're assuming you're rocking a Windows-based system. Clearly, playing sounds, text-to-speech and speech recognition are also possible on macOS and Linux boxes, but just to keep things manageable, we'll stick to Windows for this tutorial — you can search the Python Package Index (PyPI) for appropriate Mac OS X and Linux options.

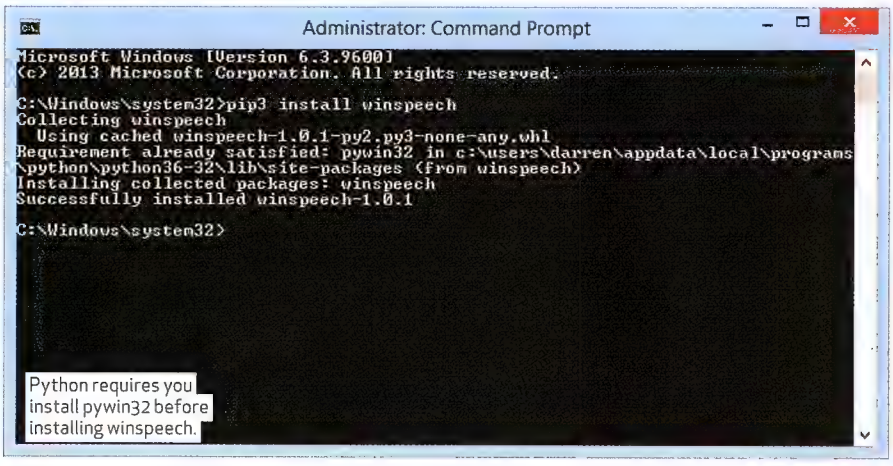
The great thing about Python on Windows is that it comes ready to go with a built-in audio-output module called 'winsound'. It's basically a Python middleware or 'wrapper' to enable your Python code to talk with Windows' audio application programming interface (API). Instead of having to deal with the complexities of Windows API requirements yourself, you write simple high-level Python code and the winsound library translates that into Window-ese. There's no need to code anything to select a sound card or set the audio output level — you just use the standard Windows audio controls for that. To begin, winsound requires you add a simple import command at the start of your code:

```
import winsound
```

From here, you can create tones, make your computer play Windows message sounds (like those played when you see message boxes appear) or play WAV audio files.

If you haven't as yet, grab the latest version of Python 3 from **python.org/downloads** and grab this month's source code file from the APC website at **apcmag.com/magstuff**. Once you've downloaded, installed and unzipped everything, launch the IDLE Python editor and open up the 'beep.py' file from this month's source code pack.


Administrator: Command Prompt
Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.
C:\Windows\system32>pip3 install pyttsx3
Collecting pyttsx3
Downloading pyttsx3-2.6.zip
Requirement already satisfied: pypiwin32 in c:\users\darren\appdata\local\programs\python\python36-32\lib\site-packages (from pyttsx3)
Installing collected packages: pyttsx3
Running setup.py install for pyttsx3 ... done
Successfully installed pyttsx3-2.6
C:\Windows\system32>
Use Python's pip3 utility to install the pyttsx3 text-to-speech library.


Administrator: Command Prompt
Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.
C:\Windows\system32>pip3 install winspeech
Collecting winspeech
Using cached winspeech-1.0.1-py2.py3-none-any.whl
Requirement already satisfied: pywin32 in c:\users\darren\appdata\local\programs\python\python36-32\lib\site-packages (from winspeech)
Installing collected packages: winspeech
Successfully installed winspeech-1.0.1
C:\Windows\system32>
Python requires you install pywin32 before installing winspeech.

MAKE A SINEWAVE

The first thing we'll do is make simple audio tones, which, in this case, are sinewaves. Winsound uses a function called 'Beep' for this and it has two parameters — frequency, or the tone of the sound, measured in Hertz as a number between 37 and 32,767; plus duration, the length of time the sound should run in milliseconds. So to create a 1,000Hz sinewave tone that lasts for two seconds, you code:

```
import winsound
winsound.Beep(1000,2000)
```

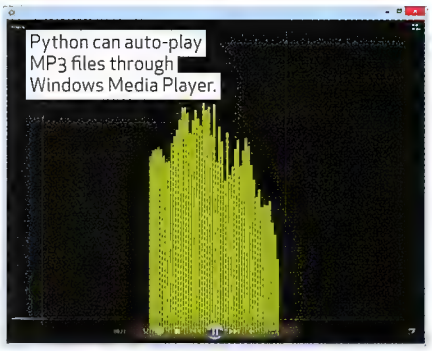
Traditionally, the 'beep' function would sound a computer's internal buzzer/speaker, but since audio now gets routed to the PC's audio engine, the output is coded as a sinewave, rather than the typically buzzy 8-bit-sounding squarewave of days gone by.

PLAYING WINDOWS' SYSTEM SOUNDS

Winsound can also tap into the Windows' system sound library and play notification and warning sounds. To implement this, you use the 'winsound.MessageBeep()' function with an appropriate parameter value. The values are: MB_OK, MB_ICONQUESTION, MB_ICONHAND, MB_ICONASTERISK and MB_ICONEXCLAMATION. So to play the 'Critical Stop' sound, you use:

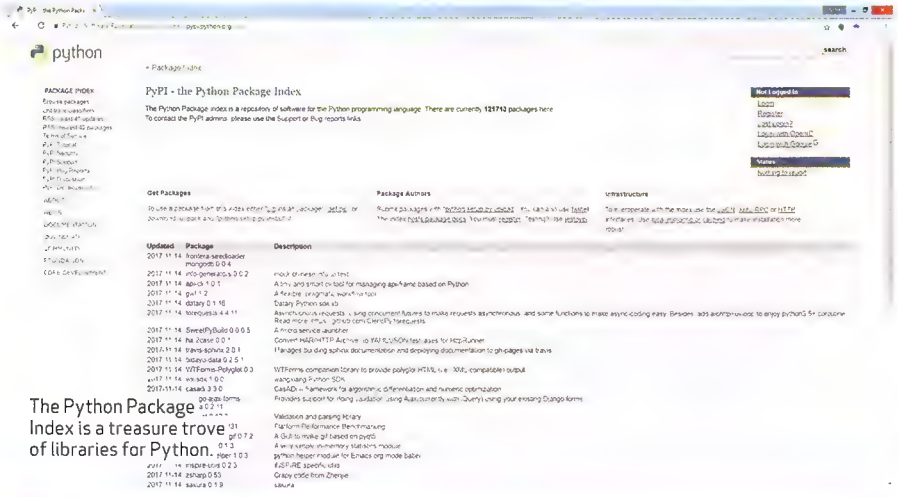
```
winsound.
MessageBeep(winsound.MB_
ICONHAND)
```

Speech recognition generally requires a good quality headset.

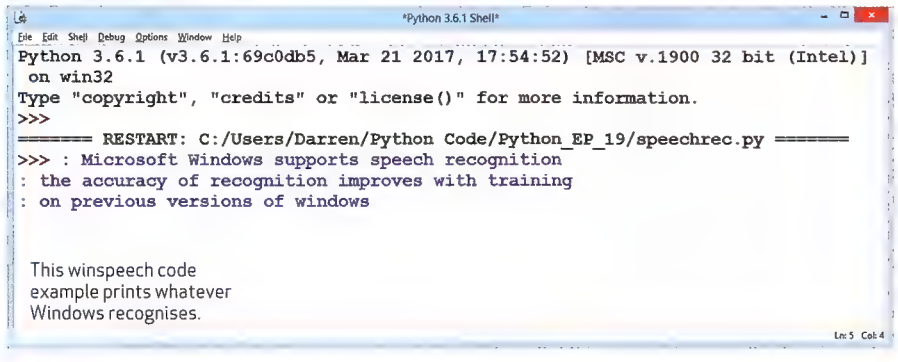


Python can auto-play MP3 files through Windows Media Player.

"The great thing about Python on Windows is that it comes ready to go with a built-in audio-output module called 'winsound'."



The Python Package Index is a treasure trove of libraries for Python.



This winspeech code example prints whatever Windows recognises.

That said, from our experience, not all values produce a sound – MB_ICONQUESTION, for example, doesn't do anything in Windows 8.1. Still, the sounds that do work are all built into the OS, so there's no need to worry about supplying audio files or setting up filepaths. There's also an alternative and that's to use the PlaySound() function and the SND_ALIAS option. Here, you'd run:

```
winsound.
PlaySound("SystemExit",
winsound.SND_ALIAS)
```

This produces the same sounds as the MessageBeep() function, but again, will be dependent on the version of Windows the code is launched on. Sure, it's not exactly exciting stuff, but still useful in the right application.

PLAYING AUDIO TRACKS

If you want a little more choice in your audio playlist, winsound will also play standard WAV audio files through the PlaySound() function. For example, to play an audio track, you'd code:

```
winsound.PlaySound("c:\music\
audio.wav", winsound.SND_
FILENAME)
```

The SND_FILENAME parameter is the required flag to tell PlaySound that the text in the string is a filename. Unfortunately, the winsound package built into Python only seems to support WAV-formatted files – we did try MP3 and AAC files, but to no avail. Still, 16-bit stereo WAV files are easy enough to create using any of the popular audio conversion tools available on the web.

USING YOUR BROWSER?

However, to get around this problem in a hurry, you could use Python's 'webbrowser' module, like this:

```
import webbrowser
webbrowser.open("c:\music\
audio.mp3")
```

Strangely, this doesn't actually open up your web browser as you'd might expect – instead, it opens up Windows

speechrec.py - C:/Users/Darren/Python Code/Python_EP_19/speechrec.py (3.6.1)

File Edit Format Run Options Window Help

```
import winspeech
winspeech.initialize_recognizer(winspeech.INPROC_RECOGNIZER)
def callback(phrase, listener):
    print(":",phrase)
    if phrase == "turn off":
        winspeech.say("Goodbye.")
        listener.stop_listening()
        quit()

listener = winspeech.listen_for_anything(callback)
```

This simple winspeech example prints whatever you say.

Ln: 7 Col: 33

Media Player, which automatically begins playing the file. The downside is there's no easy way with this method to programmatically stop playback. Still, for playing short-duration files with a minimum of code, it works and should play anything Windows Media Player will natively support. The webbrowser module is also built into the standard Python package, so there's no extra code to download and should work on any Windows computer. As a side note, if the filepath entered in the string doesn't exist, Internet Explorer opens instead.

SAY IT AGAIN, SAM!

Back in the September 2017 issue, we looked at coding Python on your Android device using the Android app, QPython3. One of the cool features it offers is the ability to tap into Google's Text-to-Speech (TTS) engine – and a damn good TTS engine it is.

But all desktop operating systems now include a TTS engine and one way to tap into the Windows' option is through the 'pyttsx3' package available from PyPI. Like 'winsound', pyttsx3 is a wrapper library for connecting to the Microsoft Speech API (SAPI). To install pyttsx3, you'll need to launch a command prompt in your Python folder and run:

```
pip3 install pyttsx3
```

Once installed, you import it into your code using the standard 'import' statement:

```
import pyttsx3
```

What's really great about pyttsx3 is that you can choose the level of interaction you want to have with the TTS engine's parameters. For basic use, you can have text to speech happening in as little as four lines of code – you import the library, initialise the TTS engine, use the say() function to enter your text and the run() function to speak it. Like this:

```
import pyttsx3
engine = pyttsx3.init()
engine.say('hello from APC magazine')
engine.runAndWait()
```

But you can also access various speech controls, such as discovering and selecting between the operating system's available voices, adjusting the speech speed or 'rate' and even setting the volume. Many of these settings can be obtained using the pyttsx3.getProperty() function and modified with pyttsx3.setProperty(). For example, we found the standard Windows speech rate on Windows 8.1 is a little fast by default, so you can slow things down by adding these two lines after the init() function:

```
rate = engine.getProperty('rate')
engine.setProperty('rate', rate-10)
```

Here, we're grabbing the current 'rate' parameter, then subtracting 10 from it to slow it down, then sending that value back to the TTS engine using the setProperty() function.

To change the voice, you first obtain a key to the 'voices' property and cycle through the available voices using:

```
import pyttsx3
engine = pyttsx3.init()
voices = engine.getProperty('voices')
for voice in voices:
 engine.setProperty('voice', voice.id)
 engine.say('hello from apc magazine')
engine.runAndWait()
```

The for-loop allows us to cycle through each voice library before we get it to say "Hello from APC magazine". You can read the full details on the readthedocs wikipage for the other functions in this library over at **pyttsx3.readthedocs.io**.

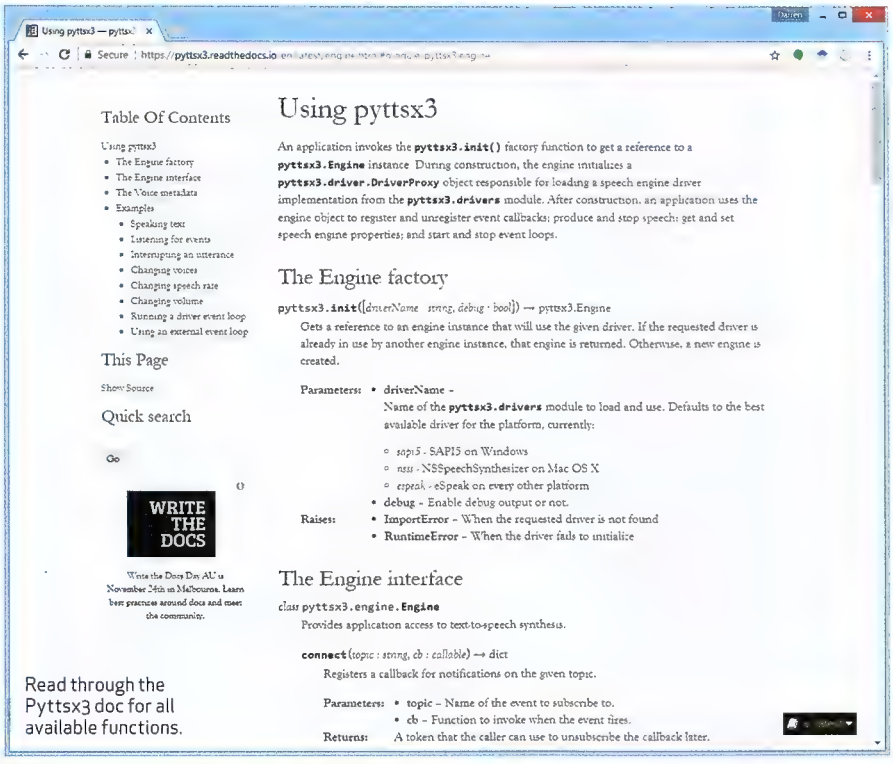
TELL THE TIME

Another quick change of code and you can get Python to literally tell you the time, using the datetime library, another built into Python:

```
import pyttsx3, datetime
...
...
engine.say(datetime.datetime.now())
...
```

The format returned by the now() function isn't particularly 'user-friendly' to listen to ('18:23:34.3234'), but if you print out the output, you'll see how it works. We'll leave it as an exercise for you to turn it into a more friendly format for speech synthesis. Why not try

Speech Recognition
Control Panel ▸ All Control Panel Items ▸ Speech Recognition
Control Panel Home
Advanced speech options
Text to Speech
Configure your Speech Recognition experience
Start Speech Recognition
Start using your voice to control your computer.
Set up microphone
Set up your computer to work properly with Speech Recognition.
Take Speech Tutorial
Learn to use your computer with speech. Learn basic commands and dictation.
Train your computer to better understand you
Read text to your computer to improve your computer's ability to understand your voice. Doing this isn't necessary, but can help improve dictation accuracy.
Open the Speech Reference Card
View and print a list of common commands to keep with you so you always know what to say.
See also
Ease of Access
Audio Devices
The more you speech train older Windows versions, the better the results.


Using pyttsx3 — pyttsx3
Secure | https://pyttsx3.readthedocs.io
Table Of Contents
Using pyttsx3
The Engine factory
The Engine interface
The Voice metadata
Examples
Speaking text
Listening for events
Interrupting an utterance
Changing voices
Changing speech rate
Changing volume
Running a driver event loop
Using an external event loop
This Page
Show Source
Quick search
Go
WRITE THE DOCS
Write the Docs Day AU is November 24th in Melbourne. Learn best practices around docs and meet the community.
Using pyttsx3
An application invokes the pyttsx3.init() factory function to get a reference to a pyttsx3.Engine instance. During construction, the engine initializes a pyttsx3.driver.DriverProxy object responsible for loading a speech engine driver implementation from the pyttsx3.drivers module. After construction, an application uses the engine object to register and unregister event callbacks; produce and stop speech; get and set speech engine properties; and start and stop event loops.
The Engine factory
pyttsx3.init([driverName : string, debug : bool]) → pyttsx3.Engine
Gets a reference to an engine instance that will use the given driver. If the requested driver is already in use by another engine instance, that engine is returned. Otherwise, a new engine is created.
Parameters:
driverName - Name of the pyttsx3.drivers module to load and use. Defaults to the best available driver for the platform, currently:
sapi5 - SAPI5 on Windows
nsss - NSSpeechSynthesizer on Mac OS X
espeak - eSpeak on every other platform
debug - Enable debug output or not.
Raises:
ImportError - When the requested driver is not found
RuntimeError - When the driver fails to initialize
The Engine interface
class pyttsx3.engine.Engine
Provides application access to text-to-speech synthesis.
connect(topic : string, cb : callable) → dict
Registers a callback for notifications on the given topic.
Parameters:
topic - Name of the event to subscribe to.
cb - Function to invoke when the event fires.
Returns:
A token that the caller can use to unsubscribe the callback later.
Read through the Pyttsx3 doc for all available functions.

creating an app that tells the time on the hour.

SPEECH RECOGNITION

Text to speech is certainly cool, but if you're going to go from text to speech, it's quite probable you'll also want to go from speech back to text again. However, speech recognition is quite a bit harder to do. Text is easily recognised, but human voices and speech patterns are analog and always changing – we all pronounce words differently and have different accents. Not only that, you need Python to access your PC's audio subsystem and the microphone channel in particular. What makes this easier to deal with is the fact that Windows has speech recognition built-in, so all we need is just a way to tap into it.

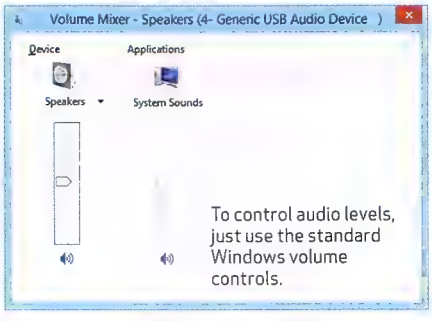
To do that, we'll use the 'winspeech' wrapper library available on PyPI, but before we can install it, we first need the Python for Windows Extensions (pywin32) package, which you'll find online at SourceForge (**tinyurl.com/yaqtjehc**). Download the latest version for your Python release (probably Python 3.6) and install it onto your system.

After that, we can 'pip' the 'winspeech' package into Python, so again, launch a command prompt and run:

```
pip3 install winspeech
```

And as we've been doing, before you begin your code, you import the winspeech library:

```
import winspeech
```



To control audio levels, just use the standard Windows volume controls.

The most significant difference with recognising speech as opposed to everything else we've done so far this month is that your code won't know when to expect that speech to arrive. We can sit there with a loop keeping an ear out, but it'd be like taking the kids on a car holiday – "Are we there yet? Are we there yet? Are we there yet...?"

To solve this issue, the author of winspeech has included a special function called a 'listener', which is basically what it sounds like – it listens out for anything Windows recognises as speech and raises a flag or 'interrupt' when recognised speech has occurred. That interrupt causes a change in code operation, pausing the main code and triggering the operation of new code that we can define. The code trigger process is often called a 'callback' and in winspeech, is designed to launch a function of your design. The basic code line looks like this:

```
listener = winspeech.listen_
for_anything(callback)
```

The listen_for_anything() function has a parameter, which is the name of the function we want it to launch when it has recognised some speech – in this example, that function is called 'callback'. If you take a look at the speechrec.py example in our source pack, you'll see the 'callback' function displays on the screen the text of the speech recognised. It has two parameters – 'phrase' contains the returned text of the speech recognised and 'listener' refers to the listener object created above.

The other cool thing about winspeech is that it doesn't just do speech recognition, but TTS as well. The example given in the winspeech docs even uses voice recognition to terminate the listening process – if you say "Turn off," it'll respond with "Goodbye" and shut-down the app for you. That's pretty cool.

You also shouldn't have far to travel for inspiration in how you could use this feature. With Google, Amazon and Apple all churning out smart speakers as fast as they can, you could have a crack at coding your own simple "Hey, Python" setup.

SPEECH RECOGNITION ACCURACY

If you're not a big user of speech recognition tech, especially on older versions of Windows (really, anything before Windows 10), be prepared for things to be less than perfect. That was my experience with Windows 8.1, but the built-in speech recognition engine will improve when you go through the training process found the Control Panel/Speech Recognition app. Given the capabilities of modern speech recognition engines from Google and Microsoft in Windows 10, the old ways are rather quaint – and a bit patchy in terms of accuracy. Still, your mileage may vary, so it's worth giving it a go.

Another alternative you may wish to look at is the 'SpeechRecognition 3.7' library, which also has support for Google's speech recognition engine – the downside here is that using Google's engine in your code requires online access.

MAKE A NOISE

Clearly, this isn't an exhaustive list of Python audio options, but it should give you a good taste of the broad functions available. Whether it's making a beep, playing audio files, generating speech or recognising it, Python is well equipped with libraries capable of tapping into the latent possibilities your operating system has waiting for you. And with Python being one of the world's most popular programming languages, if you can't find the library you need, it's likely someone's already working on it – or you could get researching and write it yourself! ■

Call of Duty: WWII's presentation is absolutely stunning.

apc RECOMMENDS

XO, PS4, PC | $99.95 | WWW.CALLOFDUTY.COM

Call of Duty: WWII

Taking the series back to where it all began.

Over the course of its last few iterations, the *Call of Duty* franchise had slipped further and further into the realm of science-fiction – much to the chagrin of its eternally ungrateful fan base.

Though the additions of gravity-defying mech suits, double jumping and wall running kept the gameplay fast and furious, last year's space-bound entry, *Call of Duty: Infinite Warfare*, seriously underperformed in terms of sales (by the series' standards, at least). The people had spoken, both with their wallets and in angry comments on forums, and what they'd asked for was a return to the era that kicked the series off in the first place: World War II.

Developer Sledgehammer Games (with help from Raven Software) has gone and delivered just that, and we're happy to proclaim that *Call of Duty: WWII* is the best *COD* game in several years. Kicking off during the D-Day invasion, *WWII* immediately lets you know that this isn't your ordinary *COD* experience. Gone is the regenerating health that has been a series staple for the last decade – chances are that you'll die several times as you attempt to make it to the top of the beach at Normandy.

Before long, you're introduced to a number of characters, most of which will remain in your squad for the rest of the game. Each of these soldiers offers a strategic perk on the battlefield that will prove immensely useful throughout the roughly six-hour-long campaign. One will replenish your ammo, another will offer health packs, and your squad leader will use his binoculars to point out enemies. These perks need to be recharged, though, so use them wisely.

The campaign offers plenty of variety throughout – a particular highlight being the *Inglourious Basterds*-style spy mission that has you masquerading as a German at a Nazi soirée. Emotional and deeply respectful of veterans, *Call of Duty: WWII*'s single-player campaign is exactly what the series needed to break out of its over-the-top funk.

Multiplayer has also received a makeover this year, allowing you to join one of five divisions: Infantry, Airborne, Armored, Mountain and Expeditionary – each one boasting unique abilities and belonging to a specific weapons class. A social hub called Headquarters lets you prepare before going into battle, allowing you to craft the perfect loadout. We're not too keen on the inclusion of loot boxes in this area, but, thankfully, the items received are merely either cosmetic or give the player an XP boost.

Fans will be happy to know that Zombies mode has been resurrected once again, proving to be as fun and intense as ever, especially when playing with friends.

More of a return to form than a total reinvention, *Call of Duty: WWII* aims to be a real crowd-pleaser and pretty much succeeds entirely.

■ Stephen Lambrechts

Verdict

Undoubtedly the best *COD* game in years, WWII brings the series back to where it belongs – on the ground.

★★★★½

You can use two guns at once, and you'll need to.

PC, PS4, XO | $99.95 | WWW.WOLFENSTEIN.COM

Wolfenstein II: The New Colossus

Over 3,000 Nazis die in this second rebooted instalment.

The second part in a proposed trilogy, *The New Colossus* is – yet again – about long time series protagonist BJ Blazkowicz kicking Nazi arse... with guns. Set in the aftermath of the first game, which saw the Nazis regrettably win World War II, *The New Colossus* spends the bulk of its time traversing a Nazi-occupied United States. Think Philip K Dick's *Man in the High Castle*, except starring a cast of underground revolutionaries hell bent on toppling the sadistic fascists... with guns.

As you'd expect, the bulk of your time spent in *The New Colossus* is shooting at baddies, and that's fine, because MachineGames' weapons are explosive, packing a punch that few other modern FPS games can. But much like the first game, *The New Colossus* doesn't coddle the player, and most will find this instalment a huge challenge compared to contemporaries like *Battlefront II* or *Call of Duty*'s campaign. While the marketing posits *The New Colossus* as an unrelenting, cathartic Nazi killing simulator, you'll actually need to resort to stealth a fair bit in this game unless you're supernaturally dextrous.

Every alt-righter's basement looks like this.

But its challenging nature isn't a negative: it makes the game more engaging and impactful, while foregrounding the urgency of both Blazkowicz and his entourage's efforts. Also, the environments are much more richly detailed and impressive when compared to the first game, making spending a lot of time in a single level isn't as draining as it used to be.

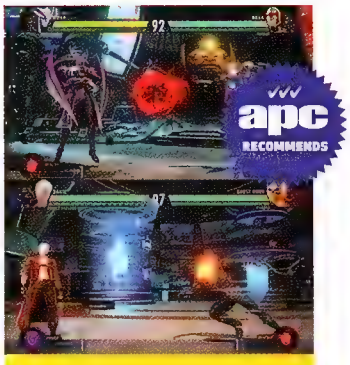
MachineGames is an absolute master of game cinematography and... guns, so they've not seen fit to 'innovate' much with this sequel – it's about as meat and potatoes as a modern blockbuster game can be. There are new weapon upgrades which help the player customise their approach marginally, but all in all, *The New Colossus* will appeal to anyone who likes straightforward single-player campaigns: a true rarity in this era of multiplayer loot box nickel and diming.

■ Shaun Prescott

Verdict

A tough, well-presented and uncompromising single-player shooter that betters its predecessor.

★★★★½



Marvel vs Capcom: Infinite

Ultron Combo finish?

PC, PS4, XO | $99.95
MARVELVSCAPCOM INFINITE.COM

MVC has changed. Making a push toward accessibility (as every fighting game does these days), its still-riotous tag-team combat has stripped things back to two characters per side from the traditional three, and entirely jettisoned support characters in favour of adding customisable movesets by way of equippable Infinity Stones. While series purists might initially balk at the idea of such simplification, in truth, these are all very good moves. With a free-form approach to combo building underpinning its explosive, anything-can-happen fights, the series' giddy, improvisational soul still burns bright in its signature action. The problem is that the rest of the game seems intent on smothering it. The issue, ironically, is most clear in the new story campaign — not quite the engaging jamboree you want it to be. While it packs in 30 characters from across both universes, the line-up is perhaps more notable for who's missing rather than who's present. It's hard to fill a Wolverine-shaped hole. The end result is a fighting game whose sparky, chaotic character now lives only in its action, but that action is still delicious and entirely gratifying.

■ David Houghton

★★★★☆

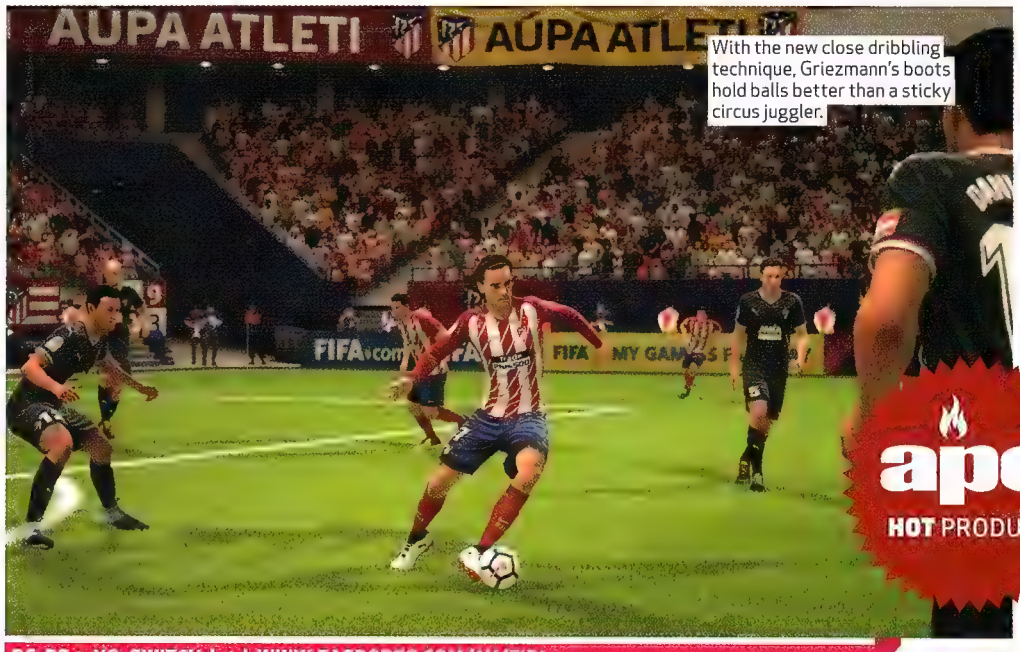
The Elder Scrolls V: Skyrim

Skyrim in bed... *Skyrim* in the bath... *Skyrim* while you're doin' your business.

SWITCH (ALSO ON PC, PS4, XO) | $79.99
ELDERSCROLLS.BETHESDA.NET

"But I don't have time to play *Skyrim* again!" is a phrase that also passed through our heads. But what if you could play Bethesda's massive open-world fantasy RPG when you'd otherwise be just idling? That's the promise of this new release of *Skyrim* on the Nintendo Switch, which adeptly squeezes hundreds of hours of dungeon delving, item crafting and corpse-looting into a portable package. What's even better is that *Skyrim* runs beautifully on the Switch, without any noticeable downgrades to either fidelity or texture detail and no frame rate hiccups. And the game still plays as well as it did six years ago — yes, the combat's a bit janky, but it's a genuine treat to be able to take such a substantial RPG with you anywhere. This is essentially the *Special Edition* version, too, (sans a few visual upgrades), including its three substantial DLC packs. We can't really fault this port in any way. If you've not played *Skyrim* and want to give it a stab, this is a great way to experience it. And if you're an old *Skyrim* veteran considering another visit to the Nord kingdom... well, now you can find the time. ■ Dan Gardiner

★★★★★



With the new close dribbling technique, Griezmann's boots hold balls better than a sticky circus juggler.

PC, PS4, XO, SWITCH | $ | WWW.EASPORTS.COM/AU/FIFA

FIFA 18

The league of extraordinarily highly paid gentlemen.

If you've any interest in football whatsoever, *FIFA*'s returning campaign mode The Journey will enthral you. After his breakthrough season, teenage star Alex Hunter's time at a top-flight British club is up when a bungled transfer sends him somewhere that was never in his plans. Once again, you'll live the turbulent life of an elite footballer, fulfilling manager targets in matches, improving your technique in training, and making 'cool' or 'fiery' remarks, both in amped-up press conferences and tender domestic scenes.

It's the insider's perspective that makes The Journey special: the emotional trauma of a career-threatening injury, the ramifications of handing in a transfer request, the heart-to-heart with a failed player-turned coach filled with regret. This offers tantalising insight into football not as a game, but as an industry. The option to ply your trade in several other countries rather than toil away in the Premier League also gives The Journey freshness. There's a reduction of filler matches, too. Tasks, such as coming on as an impact sub 20 minutes from time to grab the winner, or telling the boss which player to bring in during the transfer window then forming a telepathic partnership with them, provide tense challenges and help set it apart from Be A Pro.

The thrill of interacting with the game's greats off the pitch is electric. Twitter mentions, team offers, and an ever-growing transfer sum take Hunter from boy to brand. Plus, there's customisation. The Hackney native can rock golden boots, neck tattoos, goatees and afros.

Of course, you could always ignore all that. With *FIFA 18*, it's possible to pick a single mode and pour hundreds of hours into it across the entire year. Take Ultimate Team, in which you purchase players and build dream squads. Now there's even less emphasis on the 'purchase' part thanks to new Featured Squad Battles in which you compete against the AI-controlled ranks of real footballers, pro gamers and celebrities.

If you're wondering why we've left it to the end to talk about how *FIFA 18* actually plays, well, it's because you already know. It's the usual great game of football. Granted, there are some subtle improvements like better dribbling, allowing you to play through danger rather than around it, making going up against human opponents more dynamic. This links up with more explosive player speed. Wrong-foot a defender and you can quickly put space between you and them. It changes how you approach certain players — ie. you'll want to sit a yard off Messi and Neymar.

FIFA 18's modes are what truly put it a league above *PES 2018*. As a package, this is unparalleled. It's deep, authentic, and immensely enjoyable regardless of how you spend your time in it. ■ Ben Griffin

Verdict

Sharper players, a fab campaign and FUT's increased value make *FIFA 18* a match made in heaven.

★★★★½

PC, PS4, XO | $88 | FRACTUREDBUTWHOLE.COM

South Park: The Fractured But Whole

Rival superhero franchises go to war.

While 2014's magnificent *The Stick of Truth* skewered high fantasy, *The Fractured But Whole* is an anarchic send-up of superheroes – from comic book cliches to endless money-spinning movie franchises. You play as the mute New Kid, whose heroic deeds in the previous game are forgotten because, well, the kids are playing a different game now.

Tutored by the Coon (alter ego of Eric Cartman), you begin your adventure as a lowly sidekick and must earn the right to establish your own superhero brand and potential Netflix series. Yet no matter how hard you work, he'll still always refer to you simply as 'Buttlord'.

The Fractured But Whole is an accessible RPG with a wonderfully fun turn-based combat system. The fighting in *Stick* was cool, but lightweight. Now it's deeper, richer and more strategic. There are buffs, debuffs, elemental magic and summons, as well as superbly animated ultimate attacks. And a new grid system adds extra complexity, with chain attacks, knockbacks and powers that force you to think about where characters are positioned on the battlefield.

Environmental hazards mix things up further, with exploding chemical barrels, pools of lava, and a dad with the power to freeze your party forcing you to think carefully before each turn. It's one of the most enjoyable combat systems we've ever encountered in an RPG. There's a hell of a lot of combat, but it's so varied that we never got bored.

The story concerns two rival superhero franchises: Coon and Friends and Freedom Pals. Your stablemates include Super Craig, The Human Kite, Fastpass and the Coon himself, who each come with their own unique abilities. On the other side are Mysterion, Doctor Timothy, Tupperware and Toolshed, who you fight in Civil War missions. This rivalry is the focus of much of the storyline, although a greater evil emerges that raises the stakes and threatens both groups.

When you're not fighting, you're probably exploring the streets of South Park. Getting to wander around the town, entering buildings and talking to people, is a thrill for any fan of the show. And there are countless items, puzzles, jokes and sidequests to discover, which makes poking around in every house and store worth it. We also love how customisable your character is.

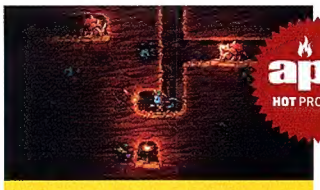
Because *TFBW* is so full of surprises, we have to avoid talking about some of its best features and moments. But if you love *South Park*, it's another faithful adaption of the series.

The story is the only real weak link, with the pace occasionally grinding to a halt, with satire that, surprisingly, lacks bite. You may find everything outside of the combat a little too familiar if you played *The Stick of Truth*, too. Otherwise, this this is *South Park* at its crude, anarchic best. ■ Andy Kelly

Verdict

A slick RPG with superb tactical combat, a detailed world to explore, and a gleefully crude sense of humour.

★★★★½



Steamworld Dig 2

Reaching new depths

PC, PS4, PS VITA, SWITCH

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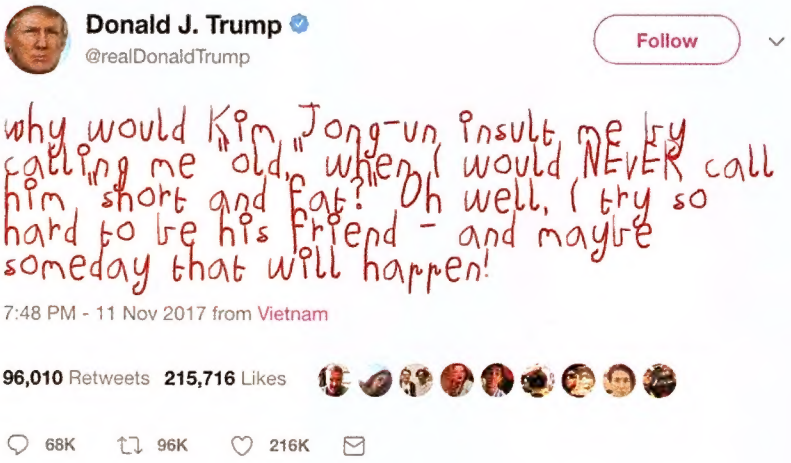
Dig down to mine resources, so you can sell them to buy upgrades, so you can dig down further and find more valuable resources. It's not the most original formula, but *SteamWorld Dig 2* wields it masterfully, filling its world with such variety that the loop never feels repetitive. You're always progressing — elements you discover are integrated into your coal-powered robot, making her the master of her environment. There are shades of *Spelunky* in the moment-to-moment adventuring, as you hop around the caves and fight creepy-crawlies, though *Dig 2* is a more relaxing and less punishing affair. For the most part, this is a gentle journey, made all the more comforting by its charming art style and jaunty music — it's ideal as a handheld game on Switch. It doesn't stray far from the template set by the first game, surprising, especially after the successful *SteamWorld Heist* (the *XCOM*-esque previous game in the series). But this is one of those perfect sequels, expanding on everything from its predecessor that we wanted more of, refining everything that was rough, and focusing on its most promising qualities. It's an under-developed tale, though, and despite a host of new locations and characters, it fails to really go anywhere. You'll find yourself far more invested in your new grappling hook than the fate of the world. ■ Robin Valentine

★★★★½


Donald J. Trump
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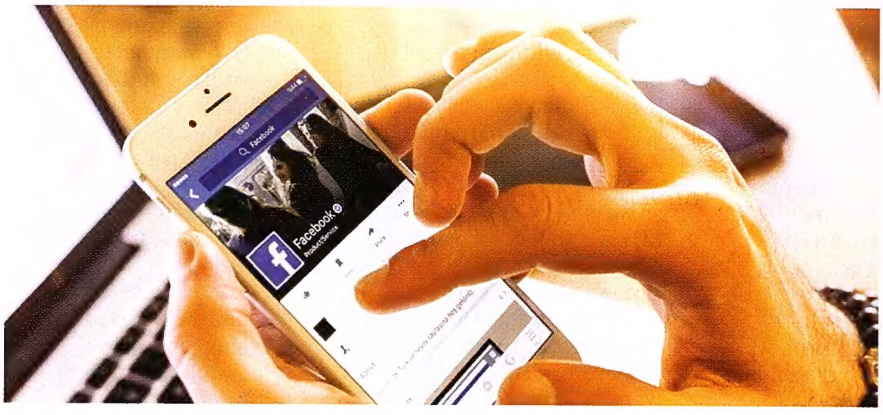
why would Kim Jong-un insult me by calling me "old," when I would NEVER call him short and fat? Oh well, I try so hard to be his friend - and maybe someday that will happen!
7:48 PM - 11 Nov 2017 from Vietnam
96,010 Retweets 215,716 Likes
68K 96K 216K

Chrome extension brings new meaning to Trump tweets

So great you won't even believe it.

Oh, internet, how we love you. Sometimes, someone out there creates something so beautiful that it makes you proud to be human. The Make Trump Tweets Eight Again Chrome extension is one of these things. US President Donald Trump himself said to his biographer that he is the same now as he was in first grade, and this extension perfectly illustrates that fact by changing Trump's tweets into a childish scrawl using different coloured crayons. True to the creator's claim, when you visit Trump's official Twitter feed and read through his tweets after installing the extension, it instantly gives his posts an added element of character (and truth). Give it a go yourselves by visiting: **tinyurl.com/apc450-eight**



Facebook's revenge porn 'solution'

FIGHTING FIRE WITH FIRE, BUT WITH NAKED PICTURES OF YOURSELF.

Revenge porn is the despicable practice of posting pictures of naked women (or men) without their consent, undertaken by spurned ex-partners. After the discovery of a 30,000-strong group of male US Marines on Facebook dedicated to sharing such images of their female colleagues, Facebook has responded with a, frankly, disturbing solution in the form of a pilot program exclusive to Aussie ladies. The company wants women to upload intimate pictures of themselves to the social media platform, which would scan them using AI and attach each with a secret code. Then if someone tried to upload that same image, the code would be recognised and Facebook would reject that photo. Facebook insists that they do not store the photos themselves, just the code. It is unclear at present whether this 'service' could help women locate photos that have already been posted without their consent, but Facebook stresses that any victims who find pictures of themselves posted on the site can immediately contact the company to get them taken down.

Artificially intelligent cookies

GREAT, ROBOTS ARE CHEFS NOW.

It seems as though, each month, we find more and more stories about AI or robots doing increasingly strange things — from naming colours or teaching you ping pong, to making your pizzas or folding your laundry. Well, this month in the 'Robots Are Doing What Now?' column, Google has put an AI to work cooking up tasty recipes — more specifically, "the best possible chocolate chip cookies using a given set of ingredients". Using Bayesian Optimization (a mathematical process far beyond the grasp of your humble writer), a team of researchers inserted particular cookie-necessary ingredients, and the system then spat out a recipe, which the team dutifully followed. After dozens of recipes were tested, scored and fed back into the system for it to learn from, the team was pleased to report that, in the end, the AI came up with "The Chocolate Chip and Cardamom Cookie". Editor willing, the *APC* team will feature a special review of the recipe in the next issue.

"Mischievous" electrician uses Twisties bags to mask his GPS location

JUST ANOTHER DAY AT THE OFFICE...

Being an electrician in Perth is apparently not a very interesting profession, as we learnt at the beginning of December. Tom Colella, a 60-year-old electrician (and wagging teenager at heart), reportedly used his industry knowledge to concoct a system to mask the signal of his GPS, allowing him to sneak off during work hours. How did he manage to do this? By shoving his company-provided GPS into empty bags of Twisties, creating a makeshift Faraday cage! All was going to plan until an anonymous letter was sent to his employer, notifying them that Mr Colella was playing golf instead of working. Points for effort, though. ■

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